DRAFT FINAL
PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT

OTHER OUTSIDE CLOSURES

(OPERABLE UNIT NO. 10)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

NOVEMBER 1991

VOLUME II

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7.0 FIELD SAMPLING PLAN

The purpose of this section of the work plan is to provide a field sampling program that will generate sufficient data to satisfy the Phase I RFI/RI objectives developed in Section 4.0. Section 7.1 presents IHSS-specific objectives. Section 7.2 summarizes site background information and rationale for the sampling and analysis and other data collection activities needed to obtain necessary data to meet the Phase I RFI/RI objectives. Section 7.3 discusses the field data collection locations and frequencies for each site. Section 7.4 describes field sampling procedures and equipment and Section 7.5 describes the analytical program including sample designation, analytical requirements, sample containers and preservation, and sample handling and documentation. Descriptions of data management procedures (Section 7.6) and QA/QC procedures (Section 7.7) complete the FSP for OU10.

7.1 OU10 PHASE I RFI/RI OBJECTIVES

The specific objectives of the Phase I RFI/RI field investigation for OU10 are as follows:

- Characterization of sources/soils at each IHSS
- Support baseline risk assessment and environmental evaluation
- Support selection of remedial action alternatives

The characterization of sources/soils at requires the determination of the type and extent of soils contamination at each IHSS as well the determination of as physical characteristics that are necessary for preliminary risk assessment modeling and if deemed necessary by the risk assessment, the preliminary evaluation of remedial alternatives.

This FSP will characterize the sources/soils conditions at the time that the field sampling is conducted. Many of these sites are still active and may be active after the field sampling program is concluded. Additional contamination caused by post-field sampling activities will not be determined by this program.

7.2 BACKGROUND AND FSP RATIONALE

The design of a FSP for sources/soils characterization requires an understanding of both the physical characteristics of the IHSS and the nature of potential sources of contamination. OU10 consists of 16 separate IHSSs that can be categorized by type and size: four are large surface storage areas greater than 100,000 ft^2 in area, four are drum storage areas less than 5,000 ft^2 in area, three are former locations of above ground tanks, two are former locations of cargo containers containing drums, one is the former location of a combined drum surface storage and cargo container area, one consists of three semisubmerged concrete tanks, and one is an underground storage tank. Of the surface storage sites and surface tanks, six are located over uncovered soils and the rest are located on asphalt or cement, although two of these were formerly uncovered soils.

The actual nature of contamination at most of the OU10 sites is currently unknown. Soils contamination could result from spills or leaking drums at most of these sites but there are no historical records indicating that these events occurred.

Given the variable nature of the sites and their unknown histories, sampling programs have to be designed to be IHSS specific. In general, a four-step sampling approach will be used for determining soils contamination at the surface storage sites where cement or asphalt is not present or was not present when contamination could have occurred. Step 1 will consist of the installation of additional monitoring wells near IHSSs that have insufficient data to determine the exact direction of groundwater flow in the vicinity of the IHSS. These wells are not for the purpose of determining whether groundwater contamination is moving from the IHSS. Water level measurements will be collected from nearby new and existing wells to map the water table beneath the IHSSs.

Step 2 will consist of screening techniques and surficial soil sampling to determine if surficial contamination exists and to attempt to define the horizontal extent of contamination. Screening techniques will include soil gas and radiation surveys at IHSSs where volatile organic compounds (VOCs) and radionuclides are suspected. Surficial soil samples will be analyzed by an on-site laboratory for semivolatile organics, by a local off-site laboratory for metals, and an off-site laboratory for radionuclides. The screening techniques and on-site and local off-site laboratory analysis will allow a quick determination of horizontal contamination at the IHSSs.

Step 3 will consist of a soil boring program to determine whether vertical contamination exists at each IHSS. Borings will be placed in the hot spots identified by the screening and surficial soil sampling step. The borings, of variable depth, will be drilled to just above the water table. At this time, samples of sediment and, if present, surface water will be collected from drainages immediately adjacent to those IHSSs where drainages or ditches exist.

Step 4 will consist of the collection of groundwater grab samples down groundwater gradient from those IHSSs where contamination has been found in the subsurface soils. These samples will be collected using the BAT® sampling system. This step will provide data for planning the location of groundwater monitoring wells in Phase II of the OU10 RFI/RI. At this time, lysimeters and tensiometers will be installed at IHSSs 170 and 176. These devices will provide information on infiltration of water and contaminants into the vadose zone at IHSSs located on natural soil and fill materials.

At the smaller sites (area less than 1,000 ft^2) where asphalt or cement is present, Step 2 will not be necessary and the field program will consist of steps one, three, and four when appropriate. The following section describes the IHSS-specific sampling programs.

7.3 SAMPLING LOCATION AND FREQUENCY

This section describes the field investigations proposed for each IHSS. Table 7-1 presents a summary of the proposed field investigations program for the Phase I RFI/RI of OU10. The sample collection effort is designed to define the horizontal and vertical extent of soil contamination. The coordinates for all borings will be determined by survey to ensure proper location of data points on facility maps.

A statistically based sampling program based on variability cannot be planned for Phase I because the soils analytical data that has been collected has never been validated and cannot be used quantitatively. However, a program can be planned for determining whether hot spots, or highly contaminated local areas are present. This methodology is appropriate for the objective of characterizing soils contamination at the OU10 IHSSs and is used for determining the sampling locations of the screening/surficial soil sampling step.

The approach used to determine the sample locations is from a monograph developed by Richard O. Gilbert and is also presented in EPA documentation (Gilbert, 1987; EPA, 1989). This method allows for the determination of a sampling grid spacing dependent on a target hot spot size and specified confidence. This method assumes the following: the target is circular or

Table 7-1 Summary of OU10 Phase I RFI/RI Field Investigations Program

IHSS	Screening Surveys		Media Sampling						No. of New Wells	Existing Wells To Be Used For Water Level Measurements
	Radiation	Soil Gas	Asphalt/ Concrete	Soil		Sediment	Surface Water[2]	Ground-water		
			No. of Samples	No. of Surficial Samples	No. of Borings/ Samples[1]	No. of Samples	No. of Samples	No. of Samples		
124	X	X		9	2/6(4)	1	1	1	1	P209289,2086, P219089,P2198489, P219189
129		X		5	1/3(2)			1	1	P416289,4486, P418289,P417889, P419689,P416789, P416689,P416589, P416889
170	X	X		60	12/36(24)			3	3	P114389,1086
174	X	X		11	3/9(6)					P114389,1086
175		X		5	1/4(3)			1	1	3386,P207489,3887
176	X	X		31	7/14(7)	2	2	3		P207689,P209789, P207889,2886, P218389,0460, 2986,P219489, P219589,3787
177	X	X	5	8	2/6(4)			3	1	5187,5287,5387, 5487
181	X		6	6	2/6(4)	1		1	1	P114789,P114889, P115489,P115589

IHSS	Screening Surveys		Media Sampling						No. of New Wells	Existing Wells To Be Used For Water Level Measurements
	Radiation	Soil Gas	Asphalt/ Concrete	Soil		Sediment	Surface Water[2]	Ground-water		
			No. of Samples	No. of Surficial Samples	No. of Borings/ Samples[1]	No. of Samples	No. of Samples	No. of Samples		
182	X		6	6	2/12(8)	1	1	1	1	P419689,P418289, 4486,P416289
205				3	1/6(4)			1	1	P416589,P416289 P419689,P416789
206				4	1/4(3)					0681,0781,1986, P119289,P119389
207				3	1/7(5)	1	1	1	1	P417889,P419689, P418289
208	X		5	5	1/6(4)	1	1			P419689,P418289, 4486,P416289
210	X	X		5	1/3(2)			1	1	3386,P207489,3887
213	X		21	56	12/48(24)	7	7	1	1	1087,4386
214	X		24	41	9/18(9)	7	7	1	1	P207489,P218089, P213689,3386
TOTALS:	11 sites	8 sites	67	258	58/188 (113)	21	20	19	14	47 wells

1 Fist number after slash represents VOA samples; number in paranthesis is for all other analysis.
2 Samples will be collected if surface water is present.

elliptical; samples are collected on a square, rectangular, or triangular grid; the distance between the grid points is much larger than the area sampled; and that the definition of the hot spot is clear and unambiguous. The last assumption is the most difficult to meet because the actual size of the hot spots is not known.

As a contaminant target hot spot size cannot be determined, a risk-based target size was used. The risk-based approach to determining target size requires the assumption that the future land-use of highest human risk is residential. Surficial contamination that covered an area the size of a residential lot was assumed to be of unacceptable risk. The risk-based target size was assumed to be the size of an average residential lot in the nearby community of Arvada (65 ft by 110 ft) (Campbell, 1991). The target was then assumed to be elliptical, with axis dimensions of 65 ft and 110 ft.

The acceptable probability (β) of not finding the target hot spot was specified as 0.1, in accordance with EPA guidance (EPA, 1990). A triangular grid was chosen because studies have shown that triangular grids are more likely to provide more information than a square grid (Gilbert, 1987). Given these variables, a grid spacing of 80 ft was determined from the monograph.

The 80-ft grid size was used for locating surficial soil sampling locations at IHSSs larger than 7,000 ft^2 in area, the area of an average residential lot. This inclues IHSSs 170, 176, 213, and 214. The soil gas and radiation screening sampling was set at a smaller grid (40 ft) to increase the probability of detecting a hot spot and because of the rapid and inexpensive nature of these methods. At sites smaller than 7,000 ft^2, a reduced grid size of 40 ft for surficial soil sampling and 20 ft for soil gas and radiation screening was used. The starting grid point at each site was chosen using random methods described in EPA guidance (EPA, 1989).

Additional surficial soil samples may be collected from areas of stained ground or in topographic depressions on the site to increase the probability of detecting hot spots. The soil gas and radiation screening may also collect additional samples to further delineate hot spots identified form the original sampling grid.

At sites smaller than 7,000 ft^2, sampling locations were generally located based upon a uniform distribution of data points within and around the perimeter of the IHSSs.

The location of soil borings will be based on the results of the surficial soil sampling and screening program. For planning purposes, 20 percent of the surficial soil sampling sites are assumed to require borings.

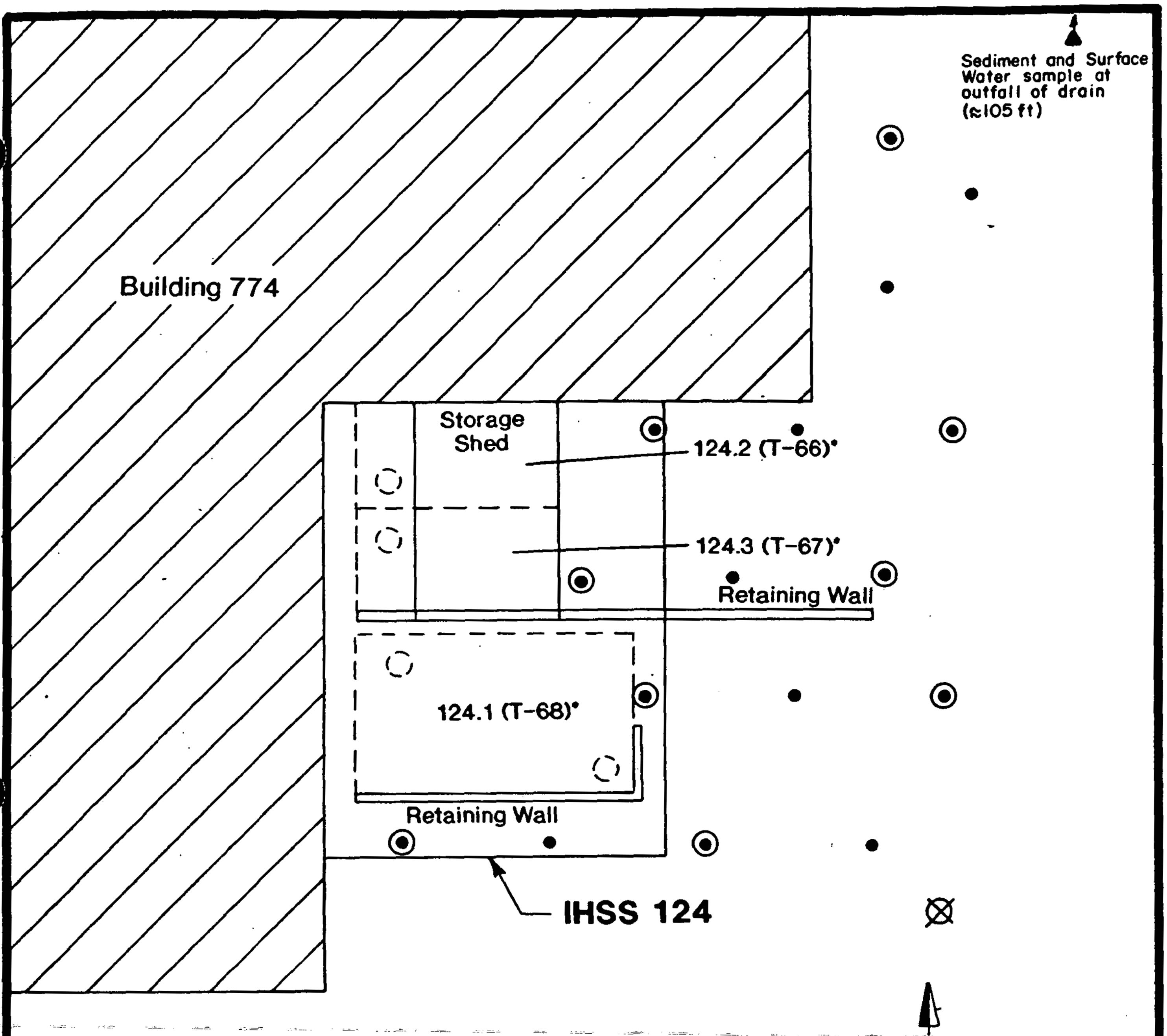
This FSP assumes that materials stored on the IHSSs will be removed from the proposed sampling locations before the field investigation begins. Otherwise, sampling locations may have to be moved because of obstructions.

A minimum of two soil samples will be collected from each stratigraphic unit encountered while drilling at each IHSS for analysis of physical parameters. These samples will be tested to determine moisture content, grain size distribution, bulk density, specific density, porosity, and permeability. A minimum of two samples will also be collected for the determination of TOC content and soil pH.

7.3.1 Radioactive Liquid Waste Storage Tanks (IHSSs 124.1, 124.2, 124.3)

Soil gas techniques will be used to determine the horizontal extent of potential contamination from leaking pipes or tanks. One of the tanks was used to store unspecified miscellaneous wastes from many sources and the wastes stored in the remaining two tanks have not been fully characterized. If potentially spilled wastes included solvents or volatile hydrocarbons, soil gas techniques can quickly locate these constituents in shallow soils beneath the site. Soil gas data collection points will be located approximately on a 20 ft grid (Figure 7.3-1). Based on results of the initial sampling, additional soil gas points may be added to further define contamination. Soil gas samples will be analyzed for common fuel constituents (benzene, ethylbenzene, toluene, xylenes), and common solvents (trichloroethene, PCE, carbon tetrachloride 1,1,1-trichloroethane).

A HPGe survey, utilizing the same locations as the soil gas and surficial soil sample programs, will be conducted to screen for areas of radioactive contamination. A total of nine surficial soil samples (Table 7-1, Figure 7.3-1) are planned to verify results from the soil gas and HPGe surveys and to define the nature and extent of potential soil contamination. Four samples will be located adjacent to the tanks to determine whether soils near the tanks have been contaminated by spills or leaks. Four samples will be located to the east of Building 774 to determine whether possible contamination has migrated away from the tanks as surface flow. One sediment and surface water sample will be collected at the outfall of a surface water drain that exits the site. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.



* IHSS's 124.1, 124.2, and 124.3 located underground. Storage shed located on top of 124.2 and 124.3. T-66, T-67, and T-68 are tank numbers which correspond to IHSS numbers.

0 20 40

Scale In Feet

Legend

- Below Ground Tank
- Manhole
- Proposed Soil Gas and Radiation Sampling Location
- Proposed Surficial Soil Sample and Radiation Sampling Location
- Proposed Well
- Proposed Sediment and Surface Water Sample Location

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FIGURE 7.3-1
Proposed Sampling Locations for Radioactive Liquid Waste Storage Tanks (IHSS 124.1, 124.2, 124.3)

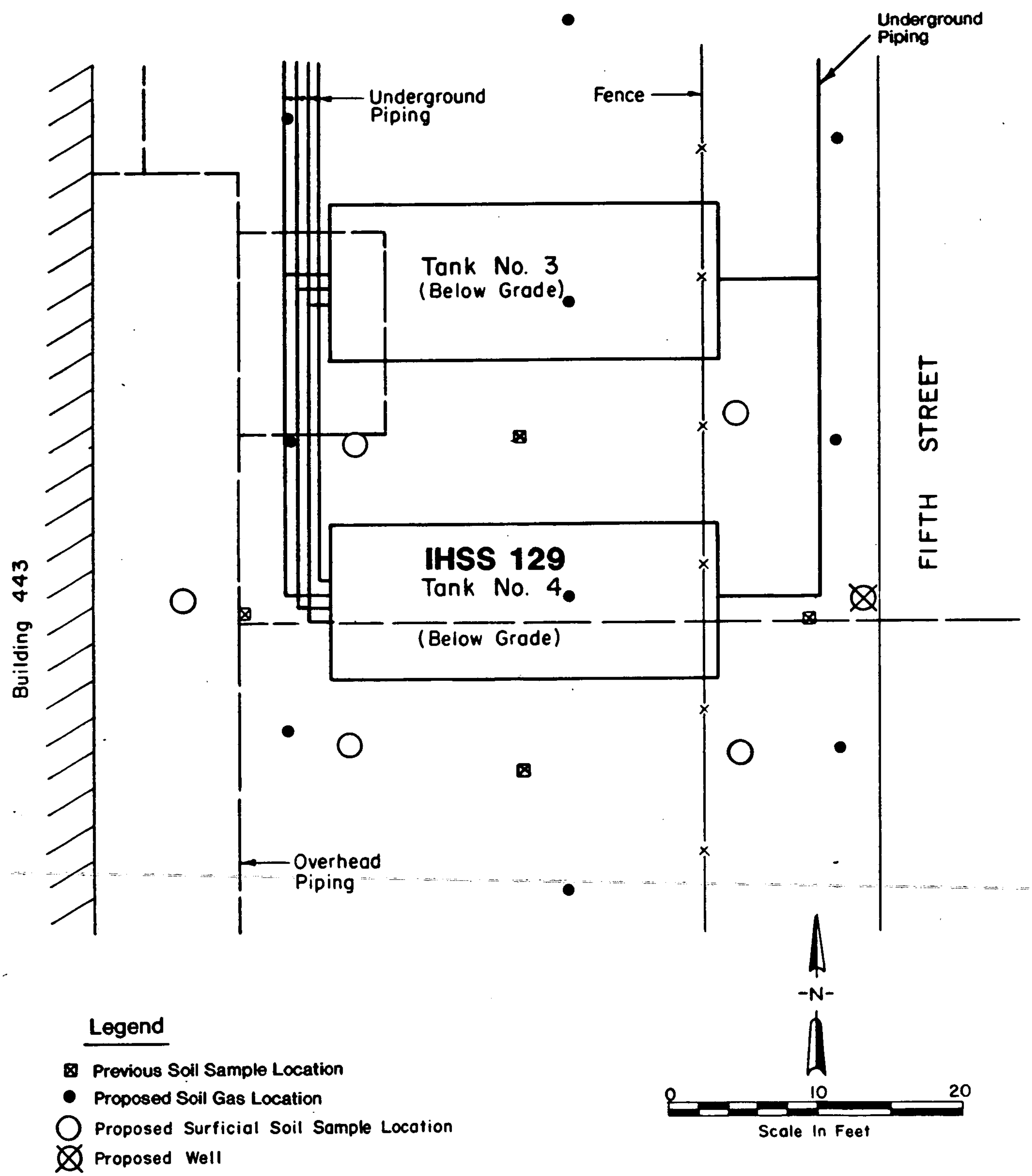
Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately two borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, six samples will be analyzed for volatile organics and 24 samples will be analyzed for all other total compound list (TCL) and total analyte list (TAL) analytes, and radionuclides.

A well will be completed upgradient of the site. Depth to groundwater is expected to be 10 to 15 ft below grade. The screen will be placed approximately 2 ft above and 8 ft below the water table. The total depth of the well will be approximately 23 ft. The well will be developed and sampled and analyzed for TCL and TAL analytes, anions, and radionuclides. Groundwater levels will be measured at five existing wells in the vicinity of IHSS 124 (Table 7-1 and Plate 1).

7.3.2 Oil Leak (IHSS 129)

Soil gas techniques will be used to determine the horizontal extent of potential contamination from leaking pipes or the tank. Soil gas is preferred to extensive soil sampling due to its ability to quickly delineate shallow occurrences of volatile hydrocarbons or solvents. Three lines of soil gas data collection points located above the subsurface piping and the tank (Figure 7.3-2) will be sampled on a 20-ft grid. Soil gas points extend north past tank No. 3. Soil gas will be analyzed for benzene, ethylbenzene, toluene, xylenes (fuel constituents) and trichloroethene, PCE, carbon tetrachloride, and 1,1,1-trichloroethane (solvents).

Five surficial soil samples are planned to verify soil gas results and document the presence or absence of soil contaminants in the vicinity of the tank (Table 7-1). Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an



Note: Tank locations are from the closure report, and have not been verified by facility drawings.

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FIGURE 7.3-2
Proposed Sampling Locations for Oil Leak (IHSS 129)

offsite local lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, three samples will be analyzed for volatile organics, and two samples will be analyzed for all other total petroleum hydrocarbons (TPH), TCL, and TAL analytes.

Depth to groundwater is estimated to be approximately 10 ft. A boring will be drilled below the water table and completed as an alluvial monitoring well (Table 7-1). Screen placement will be from approximately 2 to 4 ft above to 6 to 8 ft below the water table. Total depth of the well is anticipated to be 18 ft. This well will be developed following completion, and will be sampled and analyzed for TPH, TCL, and TAL analytes, and radionuclides. Hydrocarbon accumulation if present as light nonaqueous phase liquids (LNAPLs), will be measured to evaluate the applicability of a hydrocarbon recovery program. In addition, water levels will be measured at nine existing wells in the vicinity (Table 7-1 and Plate 1). Field observation including soil gas results may be used to change the monitoring well location if it is determined that another location would be more suitable for hydrocarbon recovery.

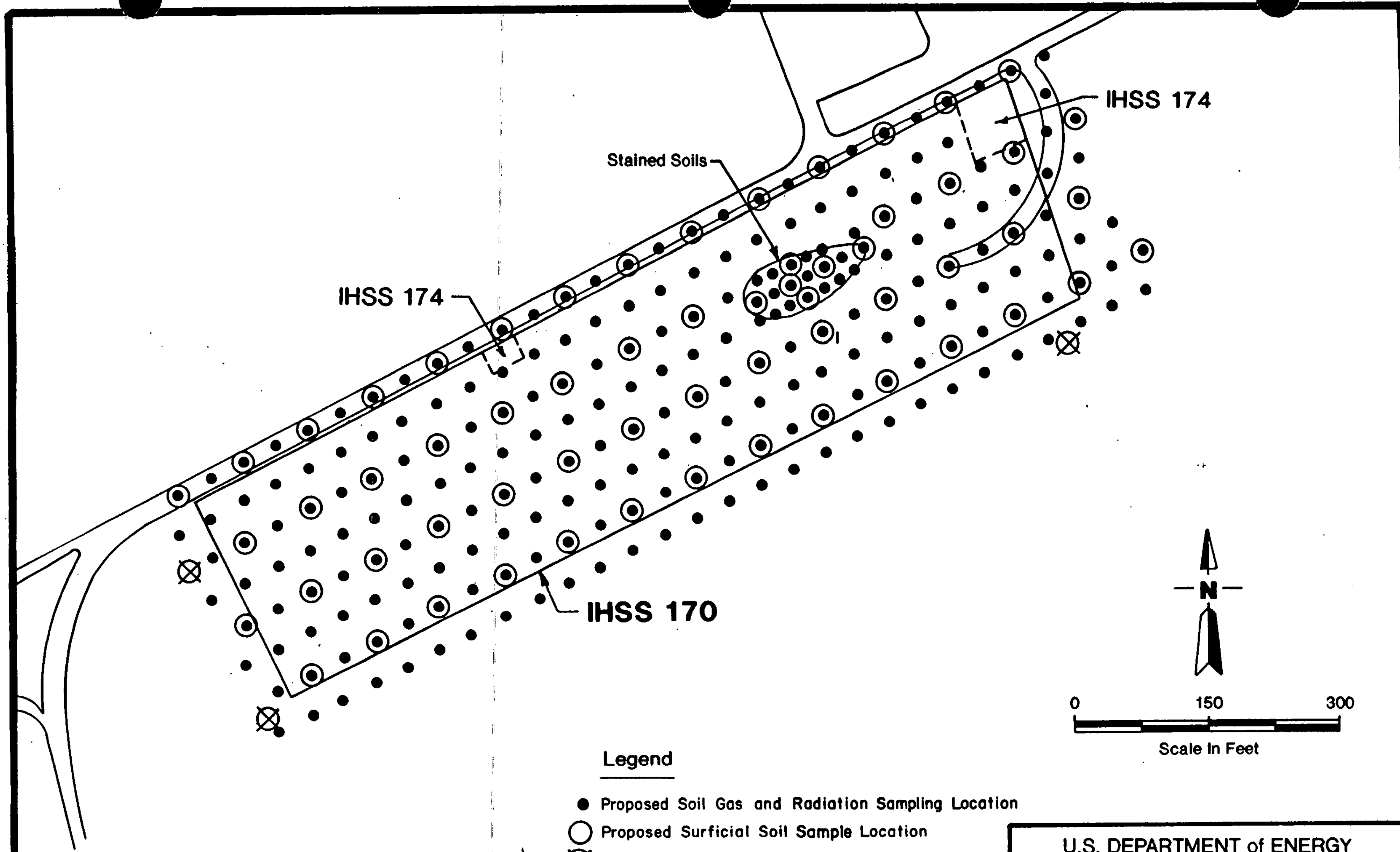
7.3.3 P.U.&D. Storage Yard - Waste Spills (IHSS 170)

HPGe and soil gas surveys will be used to locate areas of potential contamination. The surveys will be initially conducted on a 40 ft grid. The soil gas survey will be used to locate possible occurrences of solvent spills. The sampling locations will be adjusted to define anomalous hot spots if necessary. Soil samples collected from these hot spot areas will be analyzed to further assess potential contamination at the site. Constituents that have either been historically stored or detected in soil samples include solvents, acids, metals, and radionuclides. In addition, lysimeters and tensiometers will be installed and monitored at this IHSS to determine movement and chemical characteristics of water in the vadose zone.

Two approaches will be followed to select surficial soil sample locations. A total of 60 samples will be located on an offset or triangular grid with an approximate grid spacing of 80 ft according to the statistical method, outlined in the beginning of Section 7.3, and six of the 60 are placed on a smaller spacing interval due to an area of staining (Table 7-1 and Figure 7.3-3). Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately 12 borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, 36 samples will be analyzed for volatile organics and 24 samples will be analyzed for all other TPH, TCL, and TAL analytes, and radionuclides.

Three wells will be completed upgradient of the site to evaluate groundwater elevation and flow direction (Table 7-1). The wells will be screened from approximately 2 ft above the water table to 8 ft below the water table and will have a total depth of approximately 18 to 20 ft.



Legend

- ● Proposed Soil Gas and Radiation Sampling Location
- ○ Proposed Surficial Soil Sample Location
- ⊗ Proposed Well
- I Random Coordinate Generated for Sampling Grid

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FIGURE 7.3-3
Proposed Sampling Locations for
P.U. & D. Storage Yard - Waste Spills
(IHSS 170)

Groundwater samples will be analyzed for TPH, TCL and TAL analytes, anions, and radionuclides. Water levels will be measured in the new wells and two existing wells to determine groundwater flow directions (Table 7-1 and Plate 1).

7.3.4 <u>P.U.&D. Container Storage Facilities (IHSS 174)</u>

Because of the similar histories and common locations of IHSSs 170 and 174, soil gas, and HPGe screening techniques will be conducted at both IHSSs together. Soil gas and HPGe surveys will be conducted on a 20 ft grid and at suficial soil sample locations to identify potential areas of contamination.

Eleven surficial soil samples are proposed for the drum storage area of IHSS 174 (Figure 7.3-4, Table 7-1). Four samples are located at the reported perimeter of the drum storage area to document the presence or absence of contamination at the IHSS boundary. One sample is located in the center of the area. Three samples are located at previous sample sites to confirm reported elevated concentrations of 1,1,1-trichloroethane, tetrachloroethene, 4-chloro-3-methylphenol, chrysene, and vanadium. Three samples are proposed for the dumpster storage area. Review of the site history and air photographs indicate that the dumpster storage area is actually located in IHSS 170. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately three borings. In these deep borings, samples will be collected

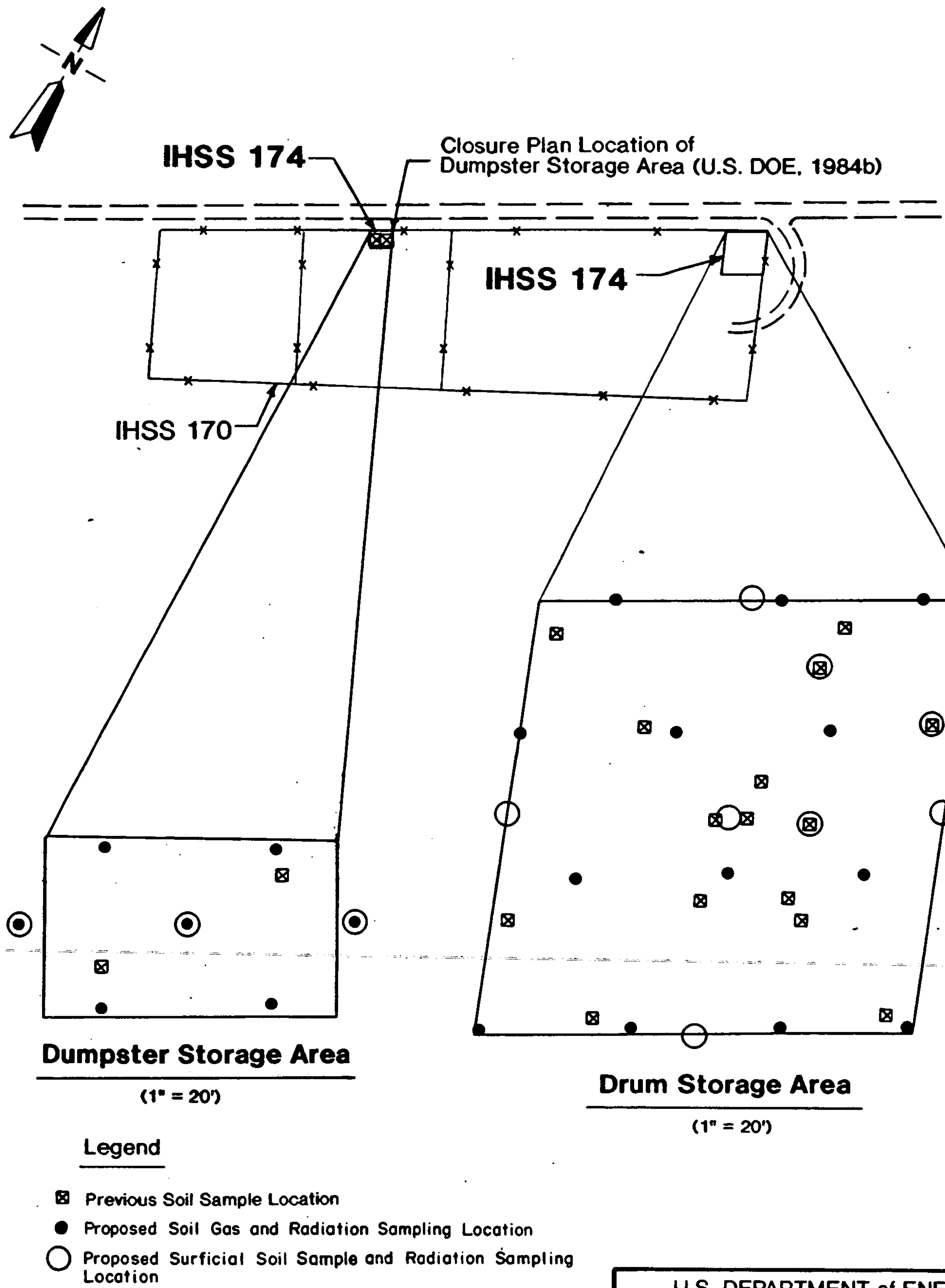

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FIGURE 7.3-4
Proposed Sampling Locations for PU & D Container Storage Facilities (IHSS 174)

to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, nine samples will be analyzed for volatile organics and six samples will be analyzed for all other TPH, TCL, and TAL analytes, and radionuclides.

7.3.5 S&W Building 980 Container Storage Facility (IHSS 175)

Soil gas techniques will be used to determine the horizontal extent of potential contamination from drums or containers stored in IHSS 175. If the potentially spilled waste included solvents or other volatile organics in shallow soil and groundwater beneath the site, soil gas techniques can quickly locate these constituents. Soil gas samples will be collected on a 20-ft grid that includes the surficial soil sampling locations, but they will be spaced at approximately 40 ft. apart (Figure 7.3-5). A HPGe survey using the same sampling locations as the soil gas and surficial soil sampling program will be conducted to screen areas of possible radioactive contamination.

Five surficial soil samples, four around the perimeter and one within the site, will be sampled (Figure 7.3-5 and Table 7-1). Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, four samples will be analyzed for volatile organics and three samples will be analyzed for all other TCL and TAL analytes, and radionuclides.

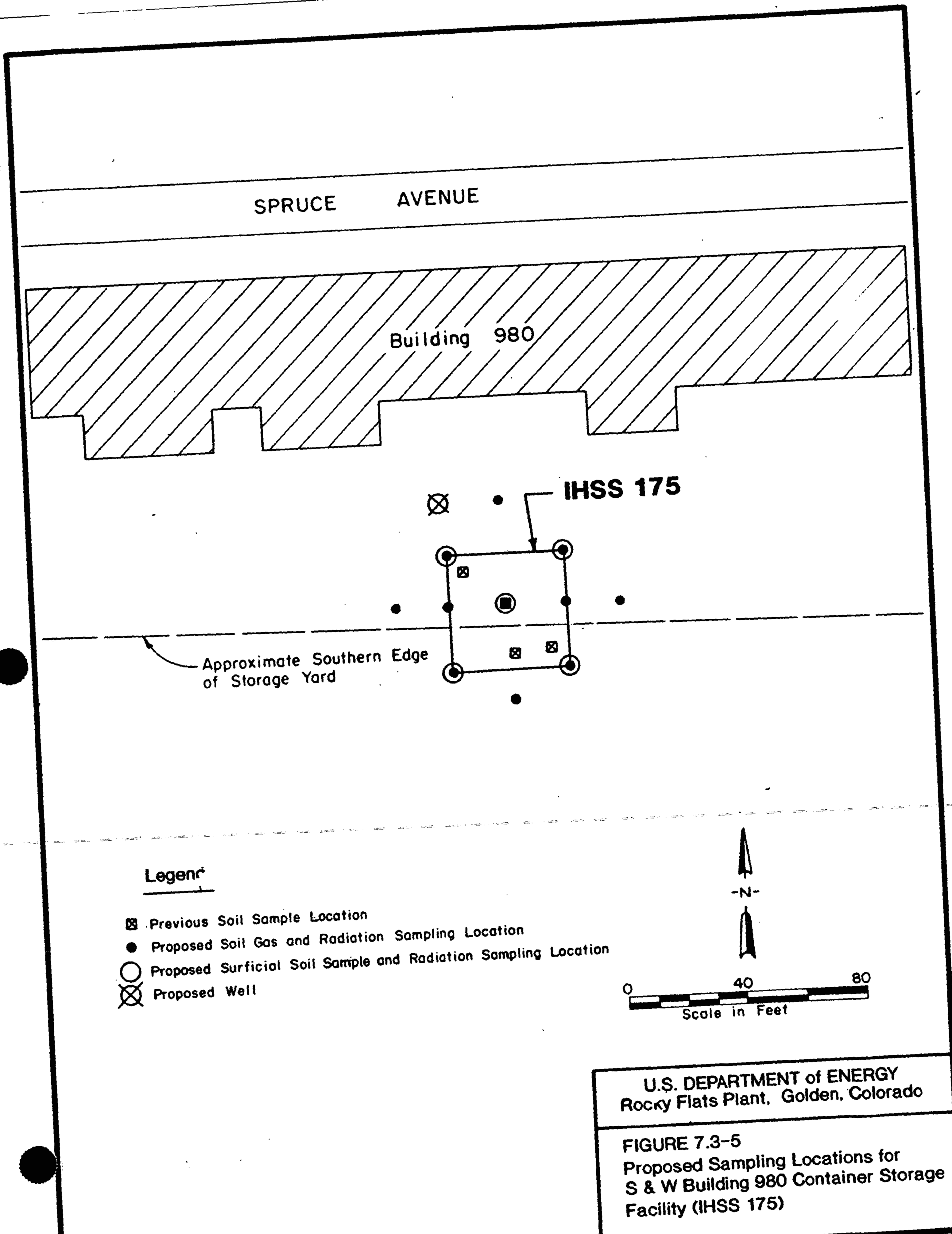

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FIGURE 7.3-5
Proposed Sampling Locations for S & W Building 980 Container Storage Facility (IHSS 175)

A well will be completed upgradient of the IHSS to the southwest (Table 7-1). The screen will be placed approximately 2 ft above and 8 ft below the water table. Precautions should be taken to prevent cross-contamination of the aquifer. The total depth of the well will be approximately 28 ft. The well will be developed, sampled, and analyzed for TCL and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at three existing wells in the vicinity (Table 7-1 and Plate 1).

7.3.6 S&W Contractor Storage Yard (IHSS 176)

Soil gas and HPGe surveys will be conducted to determine the horizontal extent of potential contamination from drums or containers stored in IHSS 176. Sampling points for these surveys will be located on a 40 ft triangular grid. In addition, lysimeters and tensiometers will be installed and monitored to determine movement and chemical characteristics of water in the vadose zone.

Thirty one surficial soil samples located on a 80 ft grid are proposed to determine the nature and extent of contamination within the site (Table 7-1 and Figure 7.3-6). The grid was established using the methods outlined in the beginning of section 7.3 with the starting point of the grid randomly chosen. Sediment and surface water samples will be collected at a culvert and a drain northeast of IHSS 176. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling

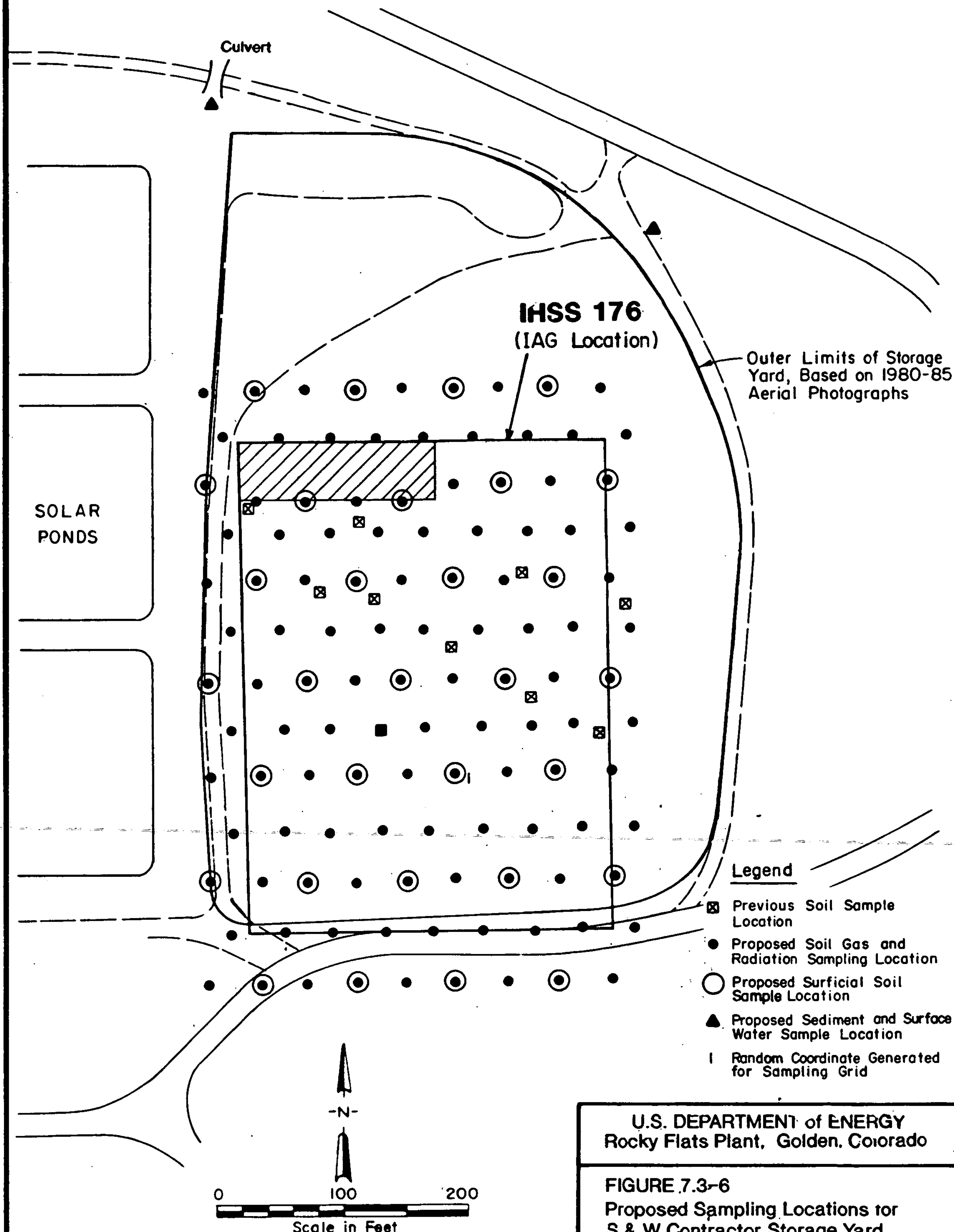

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FIGURE 7.3-6
Proposed Sampling Locations for
S & W Contractor Storage Yard
(IHSS 176)

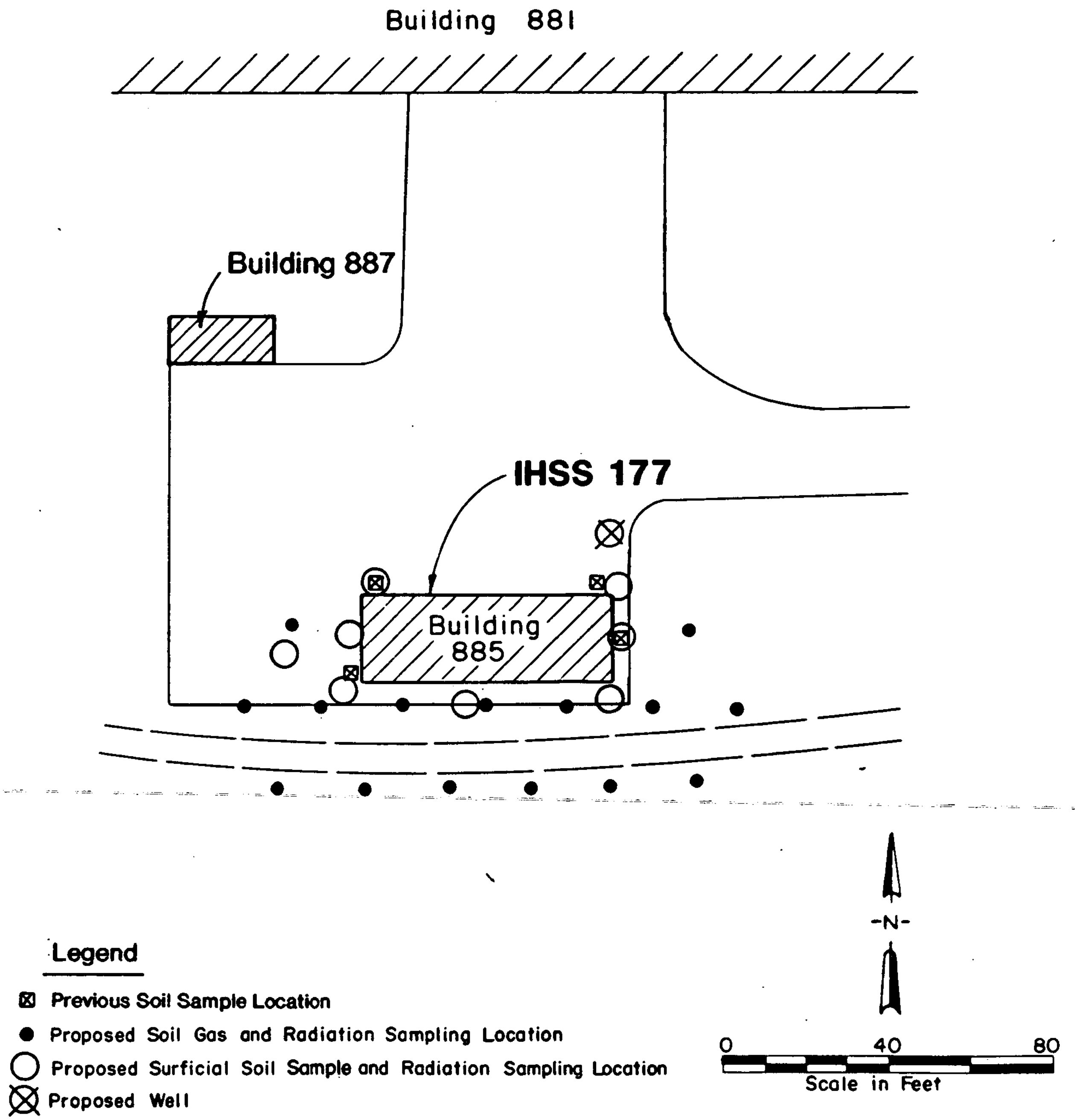

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FIGURE 7.3-7
Proposed Sampling Locations for Building 885 Drum Storage Area (IHSS 177)

to confirm the reported presence of polyaromatic hydrocarbons in soil. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite, local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately two borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, six samples will be analyzed for volatile organics and four samples will be analyzed for all other TPH, TCL, and TAL analytes, and radionuclides.

A monitoring well will be completed upgradient of the IHSS. The screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 20 ft. The well will be developed, sampled, and analyzed for TPH, TCL, and TAL analytes, anions, and radionuclides. Two existing wells will also be sampled and water levels will be measured at four wells in the vicinity of Building 885 (Table 7-1 and Plate 1).

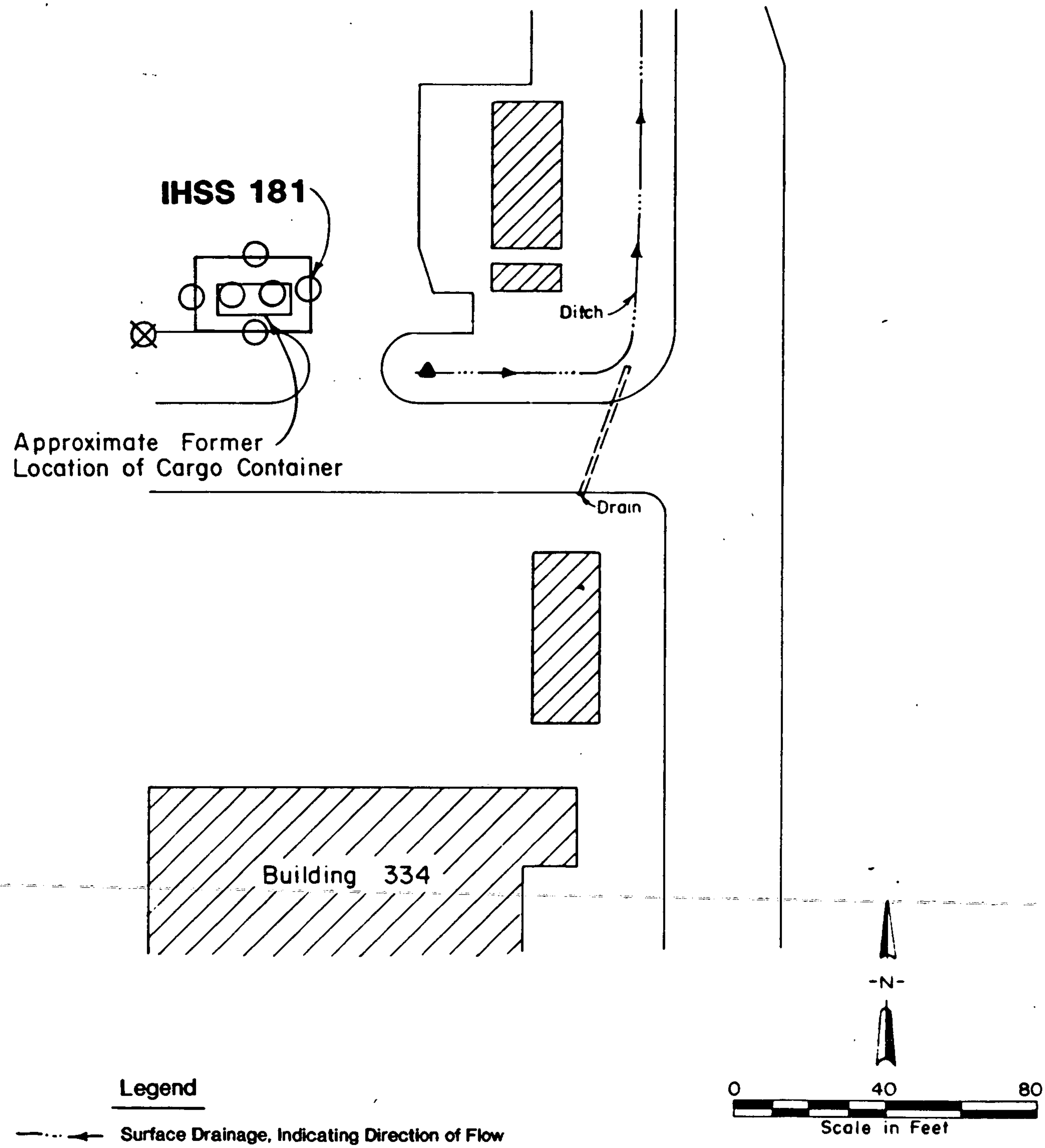
7.3.8 Building 334 Cargo Container Area (IHSS 181)

No soil gas survey is planned for IHSS 181. A HPGe survey using the same locations as the surficial soil boring program will be conducted to screen areas of possible radioactive contamination.

Six surficial soil samples are proposed for IHSS 181 during the Phase I RFI/RI (Figure 7.3-8 and Table 7-1). Four samples are located along the perimeter of the IHSS area to document the presence or absence of contamination at the IHSS boundary. Two samples are located in the interior of the IHSS area to characterize potential contamination. One sediment sample location located along a surface water ditch that drains the area will provide data on the possibility of contamination migrating from the IHSS in surface water or sediment. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately two borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, six samples will be analyzed for volatile organics and four samples will be analyzed for all other TPH, TCL, and TAL analytes, and radionuclides.

One well will be installed at the site using a deep soil boring to assess on-site water quality. The screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 18 ft. The well will be developed, sampled, and analyzed for TPH, TCL, and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at four existing wells in the vicinity (Table 7-1 and Plate 1).



Legend

- Surface Drainage, Indicating Direction of Flow
- Proposed Surficial Soil Sample and Radiation Sampling Location
- Proposed Well
- Proposed Sediment and Surface Water Sample Location

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FIGURE 7.3-8
Proposed Sampling Locations for Building 334 Cargo Container Area (IHSS 181)

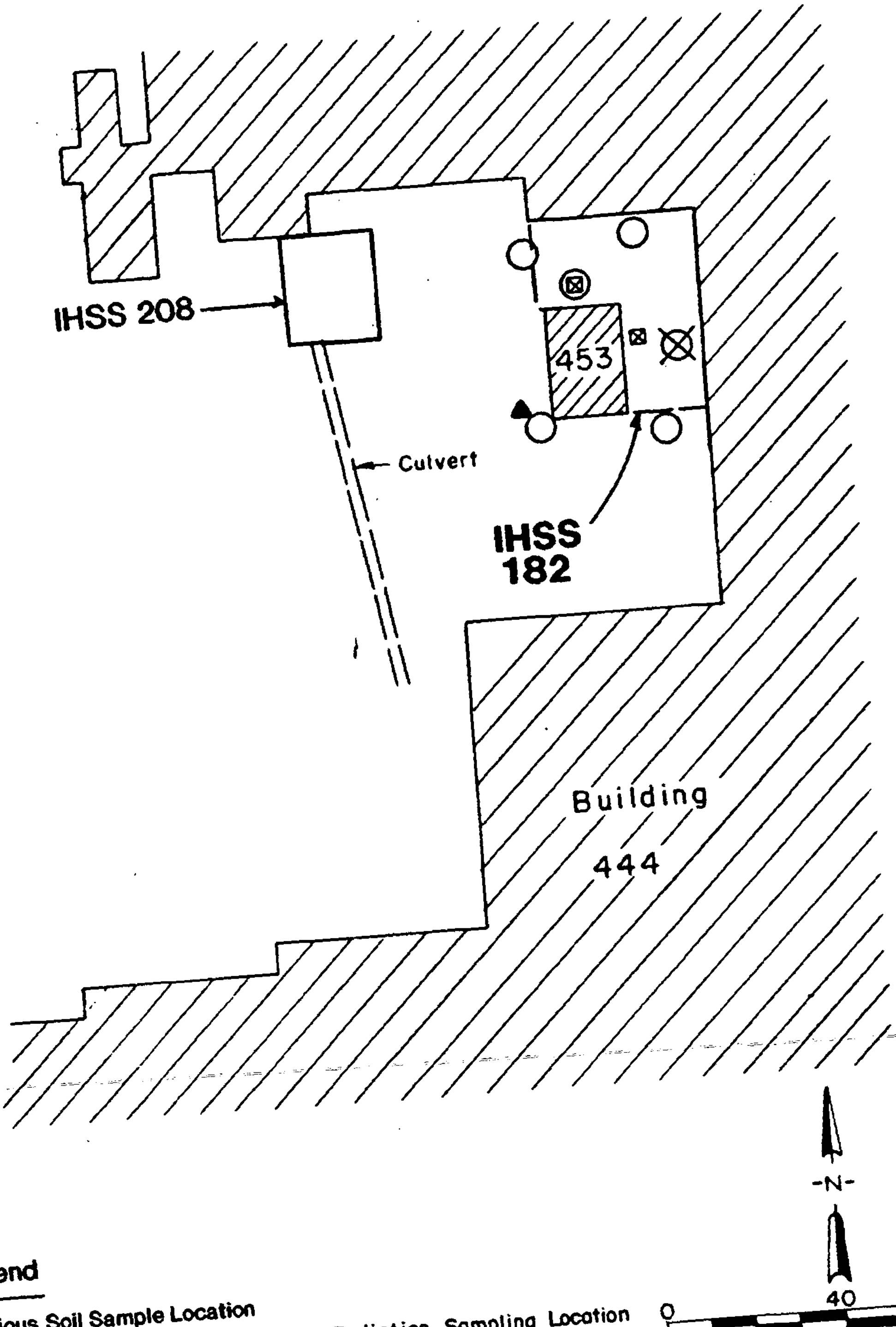
7.3.9 Building 444/453 Drum Storage Area (IHSS 182)

No soil gas survey is planned for IHSS 182. A HPGe survey using the same location as the surficial soil sampling program will be conducted to screen areas of possible radioactive contamination.

Six surficial soil samples are proposed for IHSS 182 during Phase I (Figure 7.3-9 and Table 7-1). Three samples are located at the western and southern boundary of the IHSS to document the presence or absence of contamination at the boundaries. Two samples are located in interior areas where the ground is stained and one sample is located at a site where previous sampling was performed. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately two borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, twelve samples will be analyzed for all volatile organics and eight samples will be analyzed for all other TCL and TAL analytes, and radionuclides. A sediment sample, and if possible, a surface water sample will be taken in a surface depression where water puddles at the southwest corner of Building 453.

One well will be installed and the screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 28 ft. The well will



Legend

- ⊠ Previous Soil Sample Location
- ◯ Proposed Surficial Soil Sample and Radiation Sampling Location
- ⊗ Proposed Well
- ▲ Proposed Sediment and Surface Water Sample Location

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FIGURE 7.3-9
Proposed Sampling Locations for Building 444/453 Drum Storage Area (IHSS 182)

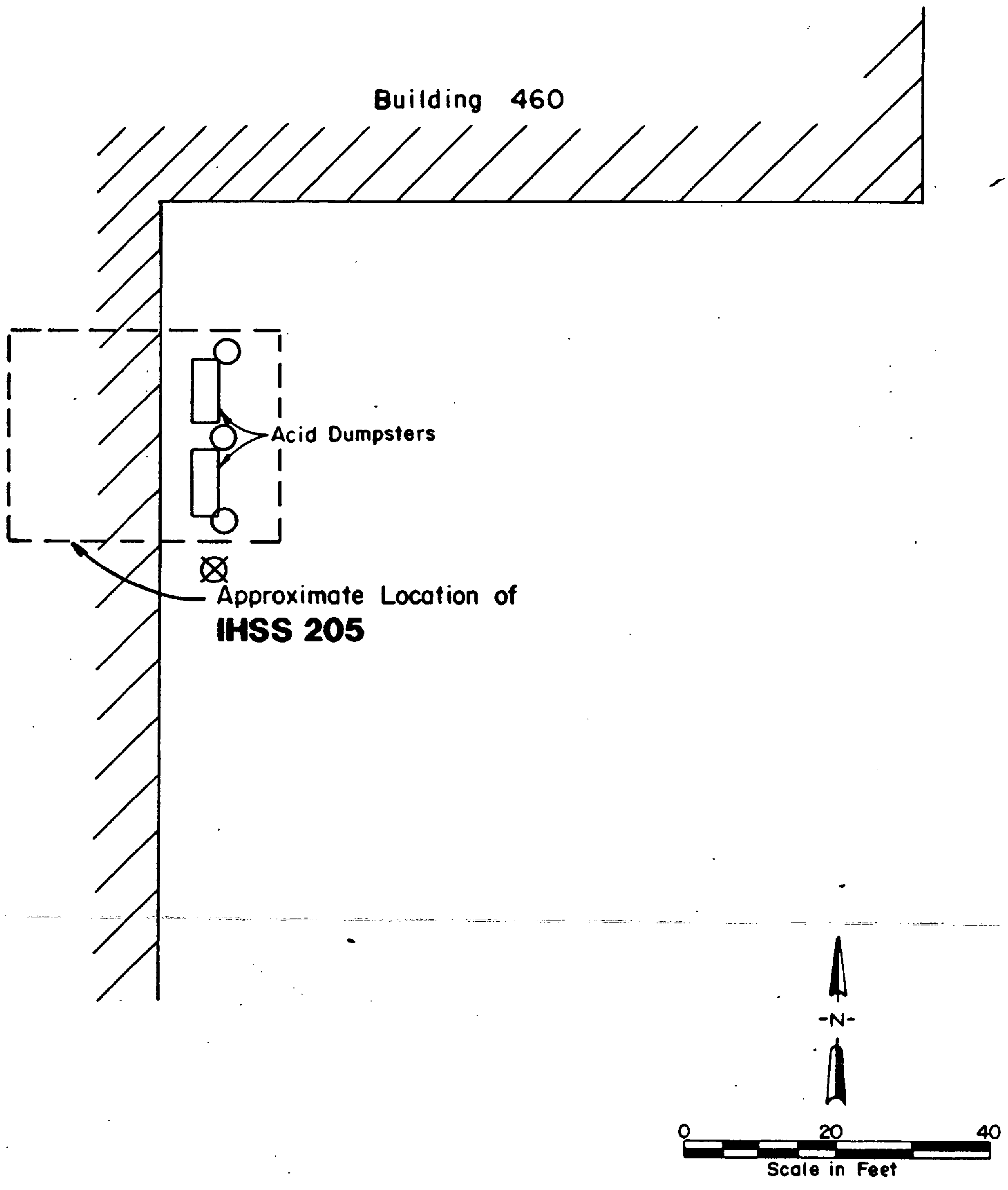
be developed, sampled, and analyzed for TCL and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at four existing wells in the vicinity (Table 7-1 and Plate 1).

7.3.10 Building 460 Sump #3 Acid Side (IHSS 205)

No soil gas or HPGe surveys are planned for IHSS 205 during the Phase I RFI/RI. Three surficial soil samples are proposed at this location (Table 7-1 and Figure 7.3-10). If visual inspection reveals indication of tank leakage, such as deteriorated or stained concrete in the tank vicinity, then one scheduled soil sample will be located at the stained location. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, six samples will be analyzed for volatile organics, and four samples will be analyzed for all other TCL and TAL analytes. As Building 460 did not have nuclear materials present, there are no radionuclide sample analyses planned.

One well will be installed and the well will be screened from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 28 ft. The well will be developed, sampled, and analyzed for TCL and TAL analytes. In addition, water levels will be measured at four existing wells in the vicinity (Table 7-1 and Plate 1).



Legend

○ Proposed Surficial Soil Sample Location
⊗ Proposed Well

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FIGURE 7.3-10
Proposed Sampling Locations for
Building 460 Sump #3 Acid Side
(IHSS 205)

7.3.11 Inactive D-836 Hazardous Waste Tank (IHSS 206)

No soil gas or HPGe surveys will be conducted at IHSS 206 during the Phase I RFI/RI. Four surficial soil samples are proposed at this location for Phase I (Table 7-1 and Figure 7.3-11). Two samples will be located where the tank was formerly located and the remaining two samples will be located where the piping exited the building and where the piping was probably attached to the tank. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, four samples will be analyzed for volatile organics and three samples will be analyzed for all other TCL and TAL analytes. No wells are planned during Phase I. Water levels will be measured at five wells in the vicinity (Table 7-1 and Plate 1).

7.3.12 Inactive Building 444 Acid Dumpsters (IHSS 207)

No soil gas or HPGe surveys will be conducted at IHSS 207. Three surficial soil samples will be scraped, one inside the berm and two outside the berm. One of the latter will be located near the drain on the southeast corner (Table 7-1 and Figure 7.3-12). A sediment and surface water sample will be taken in the drainage located to the east of IHSS 207. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

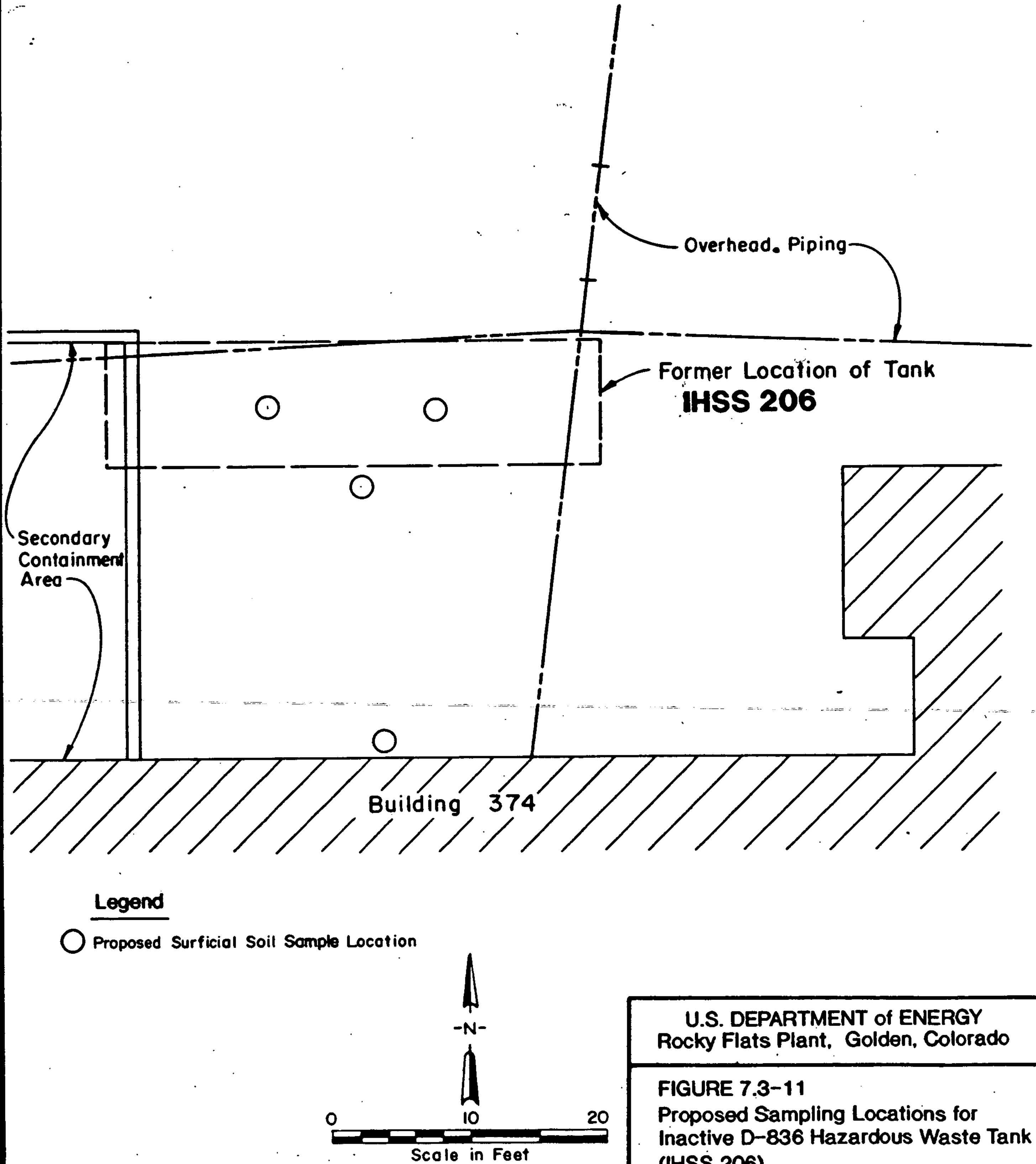

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FIGURE 7.3-11
Proposed Sampling Locations for
Inactive D-836 Hazardous Waste Tank
(IHSS 206)

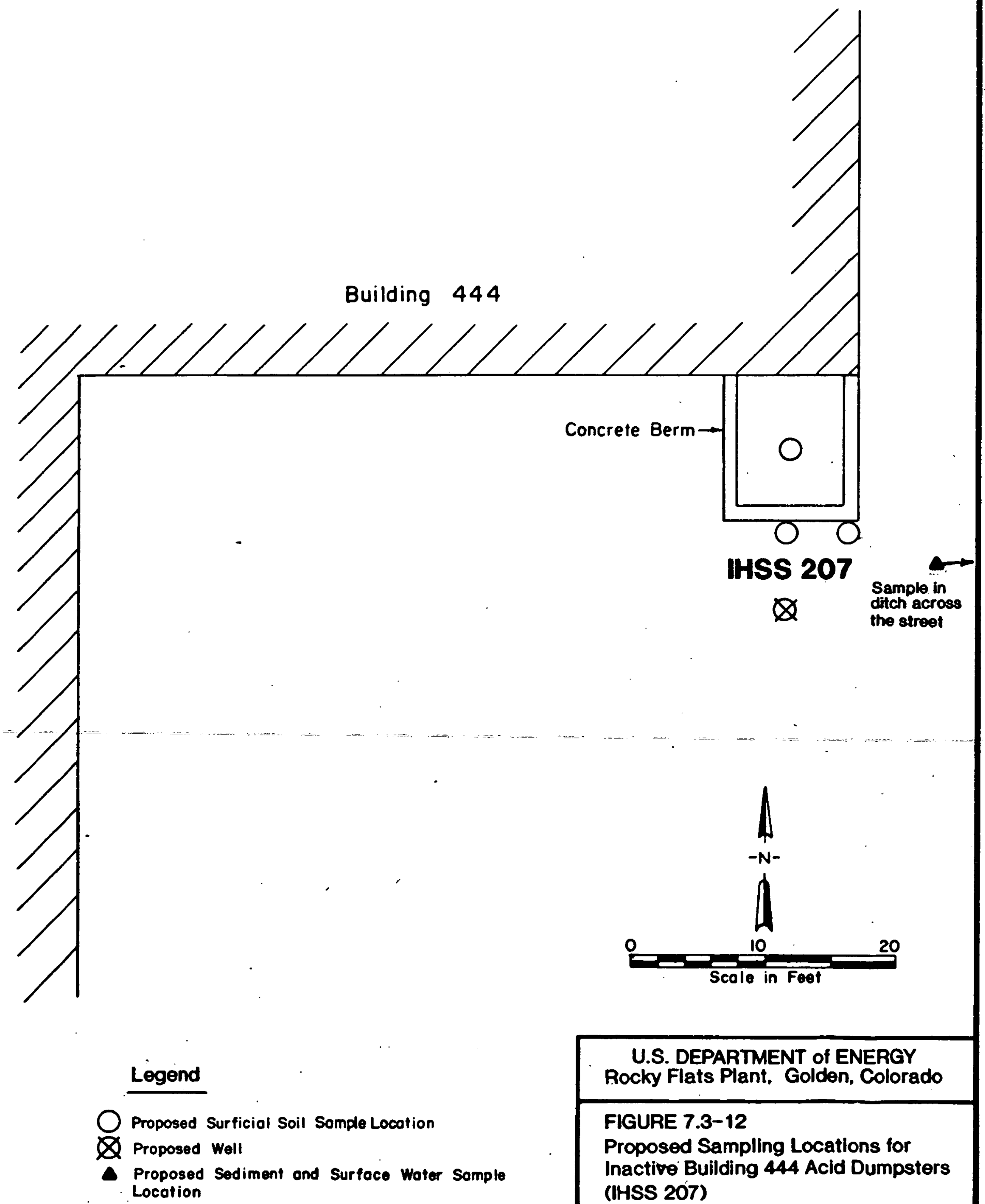

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FIGURE 7.3-12
Proposed Sampling Locations for Inactive Building 444 Acid Dumpsters (IHSS 207)

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, seven samples will be analyzed for volatile organics and five samples will be analyzed for all other TCL and TAL analytes.

A well will be completed and sampled for TCL and TAL analytes, and anions. In addition, water levels will be measured at three existing wells in the vicinity (Table 7-1 and Plate 1).

7.3.13 <u>Inactive 444/447 Hazardous Waste Storage Area (IHSS 208)</u>

No soil gas survey is planned for this IHSS. A HPGe survey will be conducted to screen areas of possible radioactive contamination. Five surficial samples are proposed for IHSS 208 during Phase I (Table 7-1 and Figure 7.3-13). Four samples are located around the perimeter and one is in the center of the IHSS. A sediment and surface water sample will be collected at the end of a culvert. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this

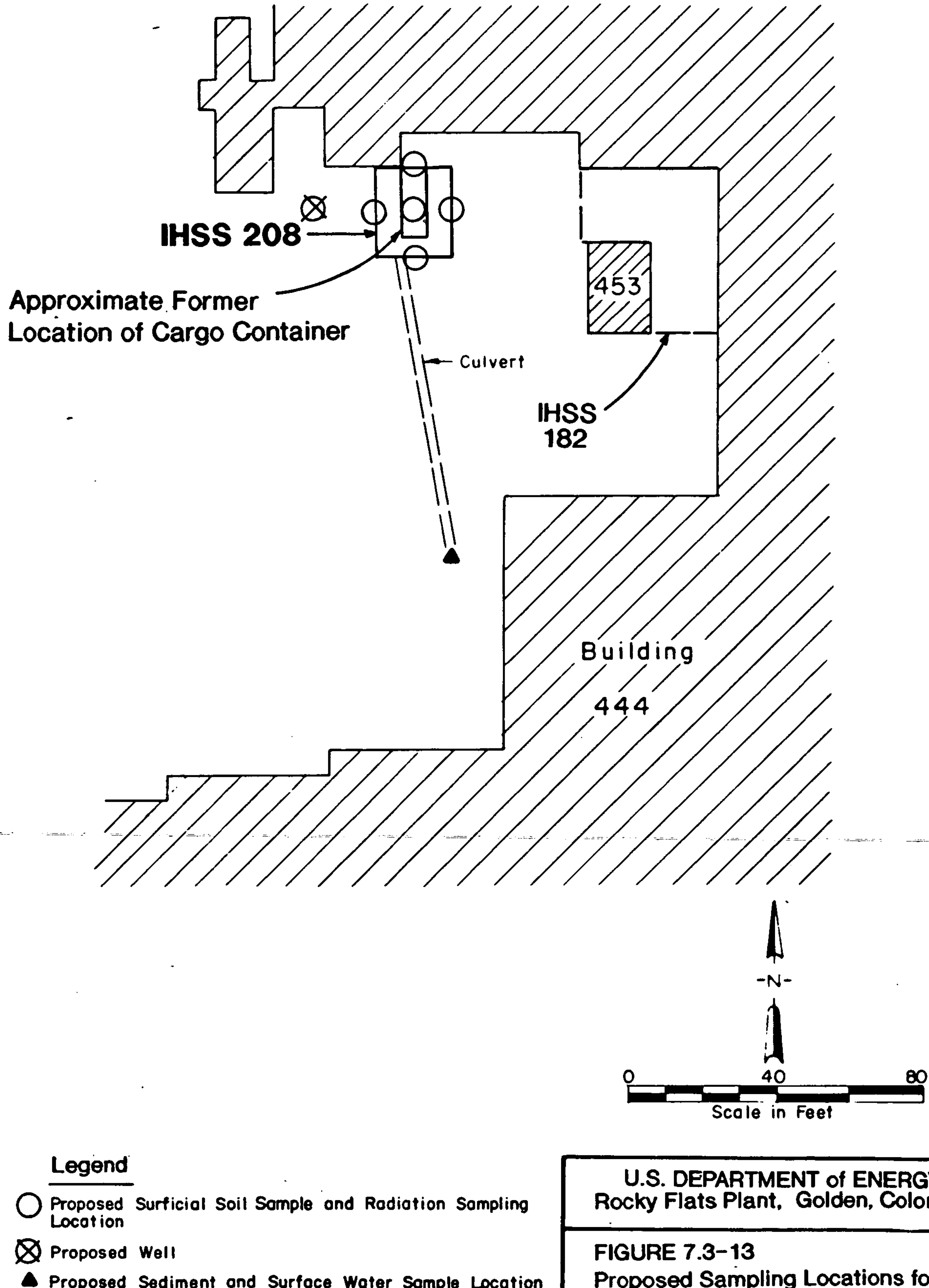

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FIGURE 7.3-13
Proposed Sampling Locations for Inactive 444/447 Hazardous Waste Storage Area (IHSS 208)

report, six samples will be analyzed for volatile organics and four samples will be analyzed for all other TCL and TAL analytes, and radionuclides.

A well will be completed and the screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 28 ft. The well will be developed, sampled, and analyzed for TCL and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at four existing wells in the vicinity (Table 7-1 and Plate 1).

7.3.14 Unit 16 Building 980 Cargo Container (IHSS 210)

A soil gas survey will be used to determine the horizontal extent of potential contamination from spilled or leaked from drums or containers stored at IHSS 210. The soil gas sampling points will be spaced 20 to 25 ft apart in the east-west direction and 10 ft apart in the north-south direction. A HPGe survey, using the same sampling locations as the soil gas and surficial soil sampling program, will be conducted to screen areas of possible radioactive contamination.

Four surficial soil samples are proposed along the perimeter of the maximum areal extent of the container area and one sample will be placed in the center of the IHSS (Table 7-1 and Figure 7.3-14). The perimeter samples will document the presence or absence of contamination at the container area boundary. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

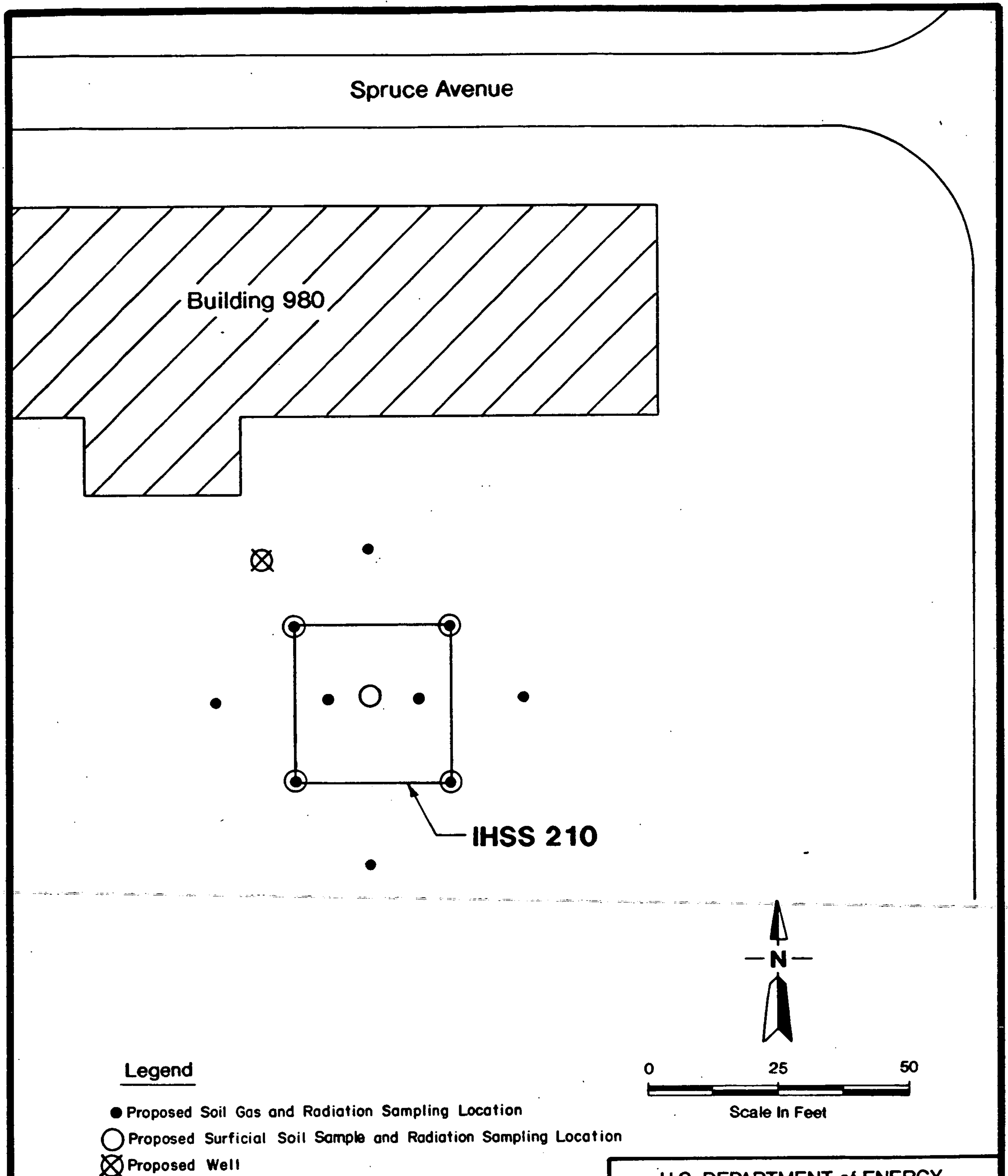

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FIGURE 7.3-14
Proposed Sampling Locations for Unit 16, Building 980 Cargo Container (IHSS 210)

Since the exact number of deep borings cannot be determined at this time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately one boring. In this deep boring, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, three samples will be analyzed for volatile organics and two samples will be analyzed for all other TPH, TCL, and TAL analytes, and radionuclides.

A monitoring well will be installed and the screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 18 ft. The well will be developed, sampled, and analyzed for TPH, TCL, and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at three existing wells in the vicinity (Table 7-1 and Plate 1).

7.3.15 Unit 15, 904 Pad Pondcrete Storage (IHSS 213)

Spills involving poorly solidified pondcrete may involve volatile and semivolatile compounds. However, due to the small volume of liquid in these wastes, the prompt cleanup by RFP employees, and transport by wind or surface water of contaminants off of the pad, it is not expected that volatile compounds will be present in soils outside the pad. Therefore, a soil gas survey is not proposed for IHSS 213. Metals will most likely be concentrated within the ditches adjacent to the site. A HPGe survey will be conducted on a 40 ft. grid to define areas of potential radionuclide contamination.

Fifty-six surficial soil samples are proposed for IHSS 213 (Table 7-1 and Figure 7.3-15). The sampling grid was determined using the methods outlined in the beginning of Section 7.3. Seven sediment and surficial water samples, if surface water exits, will be taken along the ditch. It is

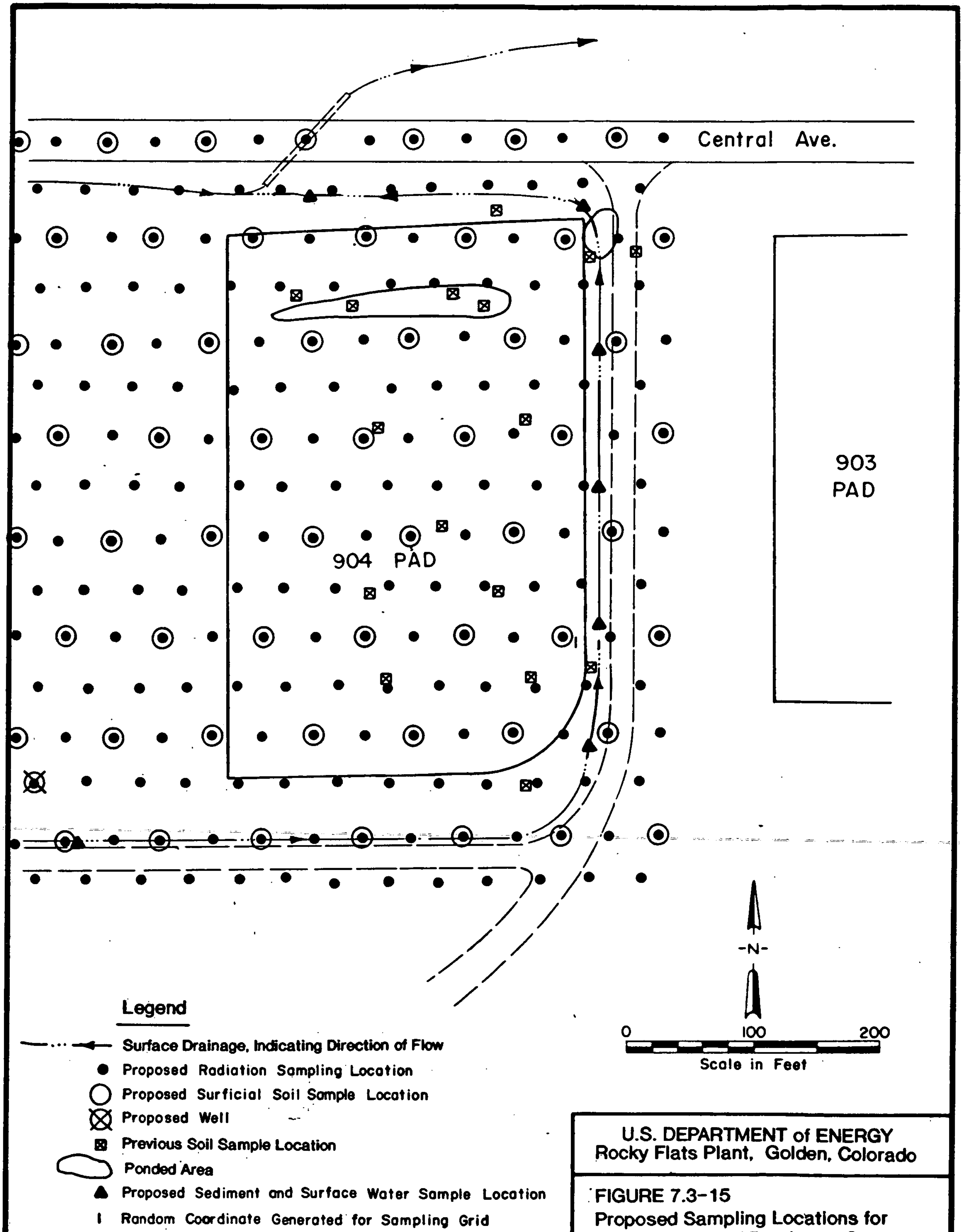

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FIGURE 7.3-15
Proposed Sampling Locations for
Unit 15, 904 Pad Pondcrete Storage
(IHSS 213)

likely that contaminants washed off the pad will migrate to the drainage ditches. These samples will document potential dispersion of contaminants along the length of the ditch. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at his time, it is assumed for planning purposes that deep borings will be drill at 20 percent of the surficial soil sampling locations which is approximately 12 borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, 48 samples will be analyzed for volatile organics, and 24 samples will be analyzed for all other TCL and TAL analytes, and radionuclides.

A monitoring well will be installed and the screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 18 ft. The well will be developed, sampled, and analyzed for TCL and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at two wells in the vicinity (Table 7-1 and Plate 1).

7.3.16 Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)

Because IHSS 214 is similar to IHSS 213, the sampling approach for IHSS 214 will generally follow that planned for IHSS 213 (Section 7.3.15). A HPGe survey will be conducted on a 40 ft. grid prior to sampling. A soil gas survey will not be conducted.

Forty-one surficial soil samples on an 80 ft. sampling grid are proposed for IHSS 214 (Table 7-1 and Figure 7.3-16). Seven sediment and surface water samples will be collected from the drainage around the IHSS. Surficial soil samples will be analyzed for semivolatile compounds onsite with a mobile lab and analyzed for metals at an offsite local lab. Surficial soil samples will also be analyzed for radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

Since the exact number of deep borings cannot be determined at his time, it is assumed for planning purposes that deep borings will be drilled at 20 percent of the surficial soil sampling locations which is approximately nine borings. In these deep borings, samples will be collected to 1 ft above the water table. Using the sampling methodology described in Section 7.4 of this report, 18 samples will be analyzed for volatile organics, and 9 samples will be analyzed for all other TCL and TAL analytes, and radionuclides.

The estimated depth to groundwater at the site is approximately 5 ft below grade. A monitoring well will be installed and the screen will be placed from approximately 2 ft above to 8 ft below the water table. The total depth of the well will be approximately 13 ft. The well will be developed, sampled, and analyzed for TCL and TAL analytes, anions, and radionuclides. In addition, water levels will be measured at four wells in the vicinity (Table 7-1 and Plate 1).

7.4 SAMPLING EQUIPMENT AND PROCEDURES

All field sampling and decontamination procedures will be in accordance with the most recent version of the RFP EMD OPS (EG&G, 1991). The version used to prepare this plan is dated February 1991. Sections of the EMD OPS are referenced where appropriate in the following sections. The EMD OPS are supplemented by EPA procedures (EPA, 1987) and American Society of Testing Materials (ASTM) standards (ASTM, 1991).

7.4.1 Surficial Soil Sampling Procedure

Surficial soil sampling will be conducted in accordance with EMD OPS GT.8 using the CDH method. A sample to be analyzed for radionuclides will be collected using a CDH sampler. Radionuclide samples will be shipped to an offsite laboratory. A second sample from each grid node will be collected using a stainless steel scoop or trowel and stainless steel lab spoon as described in EMD OPS GT.8. This second sample will be divided into fractions for semivolatile organics and metals analysis. Semivolatiles analysis will be performed by an onsite mobile laboratory. Metals analysis will be conducted at a local offsite laboratory for quick turn-around. Radionuclides will be analyzed by an offsite laboratory.

7.4.2 Radiation Survey Procedure

Radiation surveys will be performed at many of the OU10 IHSSs. Sampling locations are IHSS dependent and are discussed in Section 7.3. The radiation readings will be taken on regular spaced grids according to the procedure described in EMD OPS FO.16 and the applicable EMD OPS cross-referenced in Section 4.2 of this EMD OPS. If readings above RFP background are detected, the size of the grid will be refined to 5 ft centers around the hot spot to further define the area of radioactive contamination. If readings above background are detected near the existing boundary of OU10 IHSSs, the grid will be expanded past the existing boundary. The results of the survey will be plotted and contoured on a map. The radiation survey will be conducted using a high purity germanium (HPGe) gamma ray detector developed for high resolution spectroscopy. The HPGe has a broad energy range, exhibits high resolution, excellent gain stability, moderate area averaging, and the ability to identify and quantify all gamma ray emitting radionuclides. The EMD OPS for the HPGe is presently under development and will be available prior to any OU10 Phase I field work. Other equipment requirements are listed in Section 5.2 of EMD OPS FO.16.

7.4.3 Soil Gas Sampling Procedure

Soil gas sampling will be conducted in accordance with EMD OPS GT.09. Soil gas samples will be collected from 2 to 4 ft below the ground surface. The samples will then be injected into a portable gas chromatograph (GC) for analysis. If soil gas samples are to be collected beneath asphalt or concrete, an electrical rotary hammer will be used to open a hole to the soil surface. Other related EMD OPS can be referenced in EMD OPS GT.09, Section 4.2; and equipment requirements are listed in Section 5.3.1.1 of this EMD OPS.

7.4.4 Borehole Drilling, Asphalt Sampling, Concrete Sampling, and Soil Sampling Procedures

Borings will be drilled to determine the geotechnical characteristics of the soil, collect samples for physical and chemical analysis, determine the elevation of the water table, and install monitoring wells. Before any boreholes are drilled, the location will be cleared in accordance with EMD OPS GT.10.

Drilling will be in accordance with EMD OPS GT.02 except where material is impenetrable to this method. In the case where augering is ineffective, rotary drilling will be used in accordance with EMD OPS GT.04. Rotary drilling will be used in situations where material is impenetrable, otherwise hollow-stem augering will be the method of choice. The bedrock borings must be completed in accordance with EMD OPS GT.03. At locations with shallow borings where the drill rig cannot enter, hand augers will be used in accordance with guidelines in EMD OPS GT.02 and .08.

All drill cuttings and soil samples will be monitored for radionuclides and organic vapors in accordance with EMD OPS FO.15, Use of Photoionizing and Flame Ionizing Detectors, and EMD OPS FO.06, Field Radiological Measurements. These procedures are described in the Health and Safety Plan. Investigation-derived wastes, such as drill cuttings and residual samples, will be handled according to guidelines in EMD OPS FO.08 and .09.

Before and after drilling and sampling takes place all equipment must be decontaminated in accordance with the procedures outlined in the EMD OPS FO.03 and .04. Decontamination water will be handled according to guidelines in EMD OPS FO.07.

All of the borings not completed as monitoring wells will be grouted and abandoned immediately after drilling in accordance with procedures outlined in EMD OPS GT.05. Procedures specified in this EMD OPS are designed to prevent vertical migration of contaminants after abandonment.

Equipment requirements are listed in EMD OPS GT.02, Section 5.1; and other applicable EMD OPS are listed in Section 4.2 of this EMD OPS.

Soil and bedrock samples will be collected during drilling for visual logging in accordance with EMD OPS GT.01 and for chemical and physical analysis in accordance with EMD OPS GT.02 and FO.13. The soil and bedrock samples will be collected using a hollow-stem auger with a continuous-core sampler. Continuous core will be collected for geologic descriptions for the entire borehole depth. From this core, discrete samples will be submitted for laboratory volatile organic analyses (VOA) beginning two ft from the ground surface, continuing every four ft to the water table. In addition, a discrete VOA sample will be submitted to the laboratory if staining, discoloration, odor or other anomaly is observed during drilling. VOA soil samples should be collected in ring samplers that are capped and sealed upon recovery. In addition to the VOA samples, linear composite samples from the core will be submitted to the laboratory for analysis of the remaining chemical parameters form every consecutive 6 ft interval to 1 ft above the water table.

Soil samples for geotechnical analysis require a minimum amount of disturbance and will be collected in thin-walled metal tubes. The thin-walled metal tube will be driven into the undisturbed soils in advance of the hollow-stem auger, removed, and the tube sealed for transport to the laboratory. An EMD SOPA for this procedure is currently under review. The EMD SOPA was prepared for the Geological Characterization Program.

Asphalt and concrete samples will also be collected at some IHSSs. These will consist of two small diameter (approximately 1 inch) core plugs. The core plugs will be collected using a core drill prior to the drilling of the borehole. The samples will be handled in accordance with EMD OPS FO.13. After the asphalt or concrete sample is collected, a rotary hammer will be used to open a hole to the soil surface for soil sampling.

7.4.5 Sediment Sampling Procedure

Sediment samples will be collected from locations identified in Section 7.3. At each of these locations, a core sampler with a core liner will be used to collect the top 2 inches of bed materials for VOC analysis. Samples for nonvolatile analysis will be collected with a stainless steel scoop. Sampling procedures will follow those outlined in EMD OPS SW.6. Sediment materials will be described according to EMD OPS GT.01.

7.4.6 Surface Water Sampling Procedure

If surface water is present, surface water samples will be collected at the same time that the sediment samples are collected. Field parameters will be measured following procedures outlined in EMD OPS SW.2. Samples will be collected according to procedures specified in EMD OPS SW.3.

7.4.7 Installing and Sampling of Groundwater Monitoring Wells

All monitoring wells will be constructed with new, flush threaded PVC (EMD OPS GW.6). An auger with an I.D. a minimum 4 inches larger than the well casing O.D. will be used to drill the monitoring wells to produce a minimum annular space of 2 inches. Well construction techniques will follow procedures outlined in EMD OPS GT.06. Investigation-derived wastes such as drilling fluids, cuttings, and residual samples will be handled in accordance with guidelines outlined in EMD OPS FO.08.

Well construction techniques for all monitoring wells will follow procedures contained in EMD OPS GT.06. Monitoring well casings will be protected by the placement of steel posts around the monitoring wells, as described in EMD OPS GT.06. Pressure grouting procedures will follow guidelines outlined in EMD OPS GT.03. Additional equipment and materials that may be needed for monitoring well installation are listed in EMD OPS GT.06, Section 5.1; other related EMD OPS are cross-referenced in Section 4.2 of this EMD OPS.

The wells will be developed no sooner than 48 hours and no longer than two weeks after completion and will not be sampled until at least 2 weeks after development. Water levels will be measured in all wells and recorded as outlined in EMD OPS GW.1 and the appropriately cross-referenced EMD OPS listed in Section 4.2 of the EMD OPS. After the water levels reach static conditions, the wells will be developed utilizing low-energy methods, such as an inertial pump or bottom discharging bailer. Well development will follow procedures outlined in EMD OPS GW.2.

Prior to groundwater sampling, three casing volumes of water will be purged from the well by either bailing or pumping. Purging procedures will follow those contained in EMD OPS GW.6. Field parameters (pH, specific conductance, temperature) will be measured after every half casing volume is removed as described in EMD OPS GW.6.

Groundwater samples will be collected in a manner that will minimize the amount of agitation or limit the exposure of the sample to the atmosphere. Groundwater sampling will be by bailing or the use of a bladder pump. Samples will be collected, handled, and screened in accordance with EMD OPS GW.6 and all related EMD OPS.

All development and purge water will be handled in accordance with guidelines outlined in EMD OPS FO.08. Equipment needed for groundwater sampling is listed in EMD OPS GW.6.

Field parameters will be measured when all groundwater samples are collected. The field parameters pH, specific conductance, temperature, dissolved oxygen, total alkalinity, nitrate as N, and turbidity will be measured when groundwater samples are collected in accordance with EMD OPS GW.5 and .6. Water level measurements will be conducted in accordance with EMD OPS GW.1 and the appropriately cross-referenced EMD OPS listed in Section 4.2 of this EMD OPS.

7.4.8 Surveying of Sample Locations

The locations of all borings and surface sampling points will be paced and/or taped off prior to sampling or drilling. After sampling, drilling, or well installation, locations will be surveyed using standard land surveying techniques described in the EMD OPS GT.17. Horizontal accuracy will be ±0.5 ft for borings and ±0.1 ft for wells. Vertical accuracy will be ±0.1 ft for borings and ±0.01 ft for wells. Three elevations will be determined for each well: ground surface, top of well casing, and top of surface casing.

7.4.9 Tensiometer Installation and Monitoring Procedures

Standard tensiometers equipped with pressure transducers will be installed to measure metric potential of water in the unsaturated zone. The tensiometers will consist of a porous ceramic cup attached to a rigid plastic tube. The internal volume of the system will be completely filled with water. The pores in the cup form a continuum with the pores in the soil. Water will move either into or out of the tensiometer system, until equilibrium is attained across the ceramic cup. Multiple tensiometers allow for the determination of the direction and in some cases, the quantity of water flux from the ground surface to the water table.

Three tensiometer arrays each will be installed at IHSSs 170 and 176. Each array will consist of multiple tensiometers buried at 2 ft intervals from 1 ft above the water table to within 2 ft of the ground surface. The tensiometers will be installed by pushing them through the bottom of boreholes drilled with small diameter solid stem augers to minimize the soil disturbance. The boreholes will be backfilled with natural occurring soils to a compaction slightly greater than the bulk density of the undisturbed soils to reduce surface water infiltration, which results in abnormally low tensions in the backfill and the undisturbed soil.

Water used in the tensiometers must be deaerated and onsite purging may be necessary to prevent the formation of bubbles which can prevent accurate data collection. Purging time will be kept short to minimize wetting of soil adjacent to the porous tensiometer cup. When purging is complete, the system is closed and the soil draws water through the porous cup until equilibrium is established and the pressure is recorded by the pressure transducer and data logger.

The tensiometers will be monitored for at least one annual cycle from when the tensiometers are installed. The EMD OPS for the installation and monitoring of tensiometers is presently under development and will be available prior to any OU10 Phase I field work.

7.4.10 Suction Lysimeter Installation and Monitoring Procedures

Suction lysimeters will be installed near the tensiometers to collect in situ soil water. The lysimeter design will follow that reported by Wood (1973). The lysimeters will consist of a ceramic cup attached to a 2-ft rigid-plastic tube. Two small diameter tubes will exit the top of the plastic tube to the ground surface. Samples are collected by applying a vacuum to the system, inducing a flow of water into the cup and tube assembly. Nitrogen gas pressure is then applied to one tube and the sample is forced to the surface. A check-valve prohibits pressurization of the porous cup and the sample will not flow back into the soil.

Three lysimeter arrays each will be installed at IHSSs 170 and 176. Each array will consist of multiple lysimeters buried at 2-ft intervals from 1 ft above the water table to within 2 ft of the ground surface. The lysimeters will be installed in small diameter boreholes drilled with a solid-stem auger. The borehole annulus around the lysimeter will be packed with a silica flour and backfilled with natural materials above the lysimeter.

Samples will be collected from the lysimeters quarterly for at least one annual cycle from when they are installed. The EMD OPS for the installation and monitoring of lysimeters is presently under development and will be available prior to any OU10 Phase I field work.

7.4.11 BAT® Groundwater Sampling System

The BAT® Groundwater Sampling System will be used to collect grab groundwater samples from the top of the water table. The BAT® sampler consists of a filter tip connected to a hollow extender pipe. Inside the pipe, the filter tip is sealed from the rest of the pipe by a septum. A housing is lowered and raised in the extender pipe by wireline. The housing contains an evacuated vial in its upper end and a spring-loaded, double-ended needle on the lower end.

A sample is collected with the BAT when the housing is lowered to the filter tip. The spring-loaded, double-ended needle assemblage contracts and the needles piece the filter tip septum and the septum on the vial. The vial then fills with water. When the vial is filled, it is retrieved with the wireline.

The BAT sampler can be used with a hollow-stem auger. A borehole is drilled to within 1 to 2 ft of the water table and the BAT is driven through the end of the auger into the water table. The BAT sampling will be conducted outside the IHSS boundaries, downgradient from areas identified as contaminated during the surficial soil sampling.

An EMD OPS will be prepared for the BAT sampling prior to the OU10 field program.

7.5 SAMPLE ANALYSIS

This section describes the sample handling procedures and analytical program for samples collected during the Phase I RFI/RI investigation. It also includes discussions of sample designations, analytical requirements, sample containers and preservation, and sample handling and documentation.

7.5.1 Sample Designation

All sample designations generated for the Phase I RFI/RI will conform to the input requirements of the Rocky Flats Environmental Data System (RFEDS). Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media sample (e.g., "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including QC samples. In this manner, 99,999 unique sample numbers are available for each sample media for each contractor that contributes sample data to the database. Boring numbers will be developed independently of the sample number for a given boring. These sample numbering procedures are consistent with the RFP QAPjP.

7.5.2 Analytical Requirements

Generally, samples from the Phase I RFI/RI will be analyzed for some or all of the following chemical and radionuclide parameters:

- Nitrate
- TAL analytes
- Uranium 233/234, 235, 236, and 238
- Transuranic elements (plutonium and americium)
- Gross alpha and gross beta

- Total dissolved solids
- TCL organics
- TCL PCBs
- Inorganics
- Anions (groundwater only)
- Field parameters (water only).

The analytical suites for each OU10 IHSS were developed according to the type of waste suspected to be present at each site. Table 7-2 lists the specific analytes in the above groups and their CLP detection/quantitation limits. These analytes and limits should address the bulk of detection of soil, sediment, surface water, and groundwater contamination, if present. Nitrates are included because low-level radioactive wastes with high nitrate concentrations may be present. Metals are suspected at many of the IHSSs in OU10; therefore, all of the TAL analytes have been selected for Phase I RFI/RI analysis. Both filtered and unfiltered samples of surface water and groundwater will be collected and analyzed at each location.

The following isotopes have been selected for analysis in Phase I: uranium 233/234, uranium 235, uranium 236, and uranium 238. Plutonium is the only transuranic element that is used on the site. However, americium is a daughter product of plutonium and has been detected in soil at OU10. Therefore, plutonium and americium have been selected as Phase I radionuclide parameters. Gross alpha and gross beta are included as screening parameters because they are useful indicators of radionuclides.

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List - Metals	Detection Limits* Water (ug/l)	Soil/Sediment (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryliium	5	1.0
Cadmium	5	2.0
Calcium	5000	2000
Cesium	1000	200
chromium	10	2.0
Cobalt	50	10
Copper	25	5.0
Cyanide	10	10
Iron	100	20
Lead	5	1.0
Lithium	100	20
Magnesium	5000	2000
Manganese	15	3.0
Mercury	0.2	0.2
Molybedenum	200	40
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1.0
Silver	10	2.0
Sodium	5000	2000
Strontium	200	40
Thallium	10	2.0
Tin	200	40
Vanadium	50	10.0
Zinc	20	4.0

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List - Metals	Quantitation Limits* Water (ug/l)	Soil/Sediment (mg/kg)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10П	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
trans 1,2-Dichloroethene	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,1,2,2,-Tetrachloroethane	5	5
1,2-Dichloropropane	5	5
trans-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
cis-1,3-Dichloropropene	5	5
Bromoform	5	5
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List - Metals	Quantitation Limits* Water (ug/l)	Soil/Sediment (mg/kg)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10Π	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
trans 1,2-Dichloroethene	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,1,2,2,-Tetrachloroethane	5	5
1,2-Dichloropropane	5	5
trans-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
cis-1,3-Dichloropropene	5	5
Bromoform	5	5
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
Tetrachloroethene	5	5
Toluene	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Total Xylenes	5	5

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Semivolatiles	Quantitation Limits* Water (ug/l)	Soil/Sediment (mg/kg)
Phenol	10**	330
bis(2-Chloroethyl)ether	10**	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10**	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronapthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

3-Nitroaniline	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylanmine	10	330
4,-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10**	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzidine	20**	660
Benzo(a)anthacene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

Table 7-2 **Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits**

Target Compound List-Pesticides/PCBs	Quantitation Limits* Water (ug/l)	Soil/Sediment (mg/kg)
alpha-BCH	0.05	8.0
beta-BCH	0.05	8.0
delta-BCH	0.05	8.0
gamma-BCH (Lindane)	0.05	8.0
Heptachlor	0.05**	8.0
Aldrin	0.05**	8.0
Heptachlor epoxide	0.05**	8.0
Endosulfan I	0.05	8.0
Dieldrin	0.10	16.0
4,4'-DDD	0.10	16.0
Endrin	0.10	16.0
Endosulfan II	0.10	16.0
4,4'-DDE	0.10	16.0
Endosulfan sulfate	0.10	16.0
4,4'DDT	0.10	16.0
Methoxychlor	0.5	80.0
Endrin ketone	0.10	16.0
alpha-Chlordane	0.5**	80.0
gamma-Chlordane	0.5**	80.0
Toxaphene	1.0	160.0
Arochlor-1016	0.5**	80.0
Archlor-1221	0.5**	80.0
Arochlor-1232	0.5**	80.0
Arochlor-1242	0.5**	80.0
Archlor-1248	0.5**	80.0
Arochlor-1254	1.0**	160.0
Arochlor-1260	1.0**	160.0

Table 7-2 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Radionuclides	Required Detection Limits* Water (pCi/l)	Soil/Sediment (pCi/g)
Gross Alpha	2	4 dry
Gross Beta	4	10 dry
Uranium 233+234, 235, and 238 (each species)	0.6	0.3 dry
Americium 241	0.01	0.02 dry
Plutonium 239 + 240	0.01	0.03 dry
Tritium	400	400 (pCi/ml)
Cesium 137	1	0.1 dry
Strontium 89 + 90	1	1 dry

Parameters Exclusively for Groundwater Samples	Detection Limits* Water (pCi/l)
Anions	10
Carbonate	10
Bicarbonate	5
Chloride	5
Sulfate	5
Nitrate as N	
Field Parameters	
pH	0.1 pH unit
Specific Conductance	1
Temperature	
Dissolved Oxygen	0.5
Barometric Pressure	
Indicators	
Total Dissolved Solids	5

*Detection and quantitaion limits are highly matrix dependent. The limits listed here are the minimum achievable under ideal conditions. Actual limits may be higher.

**The laboratory Practical Quantification Limits (PQLs) for these analytes exceed ARARs.

Volatile and semivolatile organics have been detected at concentrations above the detection limit in soil and have historically been stored at most of the OU10 IHSSs. Therefore, all of the TCL volatile and semivolatile organics will be included in the Phase I RFI/RI analyses.

The analytical parameters for the soil gas surveys at OU10 are TCE, 1,2-DCE, 1,1,1-TCA, methylene chloride, toluene, 2-butanone, acetone, ethylbenzene, PCE, carbon tetrachloride, and xylene (total). Table 7-3 lists the detection limits proposed for these parameters during the soil-gas survey.

7.5.3 Sample Containers and Preservation

Sample volume requirements, preservation techniques, holding times, and container material requirements are dictated by the media being sampled and by the analyses to be performed. The matrices to be analyzed include soils and sediments, and the water matrices for analysis will include surface water and groundwater. Tables 7-4 and 7-5 list the analytical parameters of interest in OU10 for water and soil matrices, along with the associated container size, preservatives (chemical and/or temperature), and holding times. Additional specific guidance on the appropriate use of containers and preservatives is provided in EMD OPS FO.13 (Containerizing, Preserving, Handling, and Shipping of Soil and Waste Samples).

7.5.5 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and

Table 7-3 Phase I Investigation Soil Gas Parameters
and Proposed Detection Limits

Sample Type	Detection Limit (μg/l)
Acetone	1
Carbon tetrachloride	1
Ethylbenzene	1
Hydrogen sulfide	1
Methylene chloride	1
Methane	1
PCE	1
TCE	1
Toluene	1
Xylenes (total)	1
1,1,1-TCA	1
1,2-DCE	1
2-Butanone	1

Note: Detection limits are a function of the detector type and injection volume. Thus, the detection limit may vary.

Table 7-4 Sample Containers, Sample Preservation, and Sample Holding Times for Water Samples

Parameter	Container	Preservative	Holding Time
Liquid Samples - Low to Medium Concentration			
Organic Compounds:			
Purgeable organics (VOCs)	2 x 40 mℓ VOA vials with teflon-lined septum lids	Cool, 4°C[a] with HCL to pH<2	7 days 14 days
Extractable organics (BNAs), pesticides, and PCBs	1 x 4 ℓ amber[b] glass bottle	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 1 ℓ polyethylene bottle	Nitric acid pH<2; cool, 4°C	180 days[c]
Cyanide	1 x 1 ℓ polyethylene bottle	Sodium hydroxide[d] pH>12; cool, 4°C	14 days
Anions	1 x 1 ℓ polyethylene bottle	Cool, 4°C	14 days
Sulfide	1 x 1 ℓ polyethylene bottle	1 ml zinc acetate sodium hydroxide to pH>9; cool, 4°C	7 days
Nitrate	1 x 1 ℓ polyethylene bottle	Cool, 4°C	48 hours
Total dissolved solids (TDS)	1 x 1 ℓ polyethylene bottle	Cool, 4°C	48 hours
Radionuclides	1 x 1 ℓ polyethylene bottle	Nitric acid pH<2	180 days

a Add 0.008 percent sodium thiosulfate (Na2S203) in the presence of residual chlorine.
b Container requirement is for any or all of the parameters given.
c Holding time for mercury is 28 days.
d Use ascorbic acid only if the sample contains residual chlorine. Test a drip of sample with potassium iodine-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.

Table 7-5 Sample Containers, Sample Preservation, and Sample Holding Times for Soil Samples

Parameter	Container	Preservative	Holding Time
Soil or Sediment Samples - Low to Medium Concentration			
Organic Compounds:			
Purgeable organics (VOCs)	1 x 4 oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days 14 days
Extractable organics (BNAs), pesticides, and PCBs	1 x 8 oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 8 oz wide-mouth glass jar	Cool, 4°C	180 days[a]
Cyanide	1 x 8 oz wide-mouth glass jar	Cool, 4°C	14 days
Sulfide	1 x 8 oz wide-mouth glass jar	Cool, 4°C	28 days
Nitrate	1 x 8 oz wide-mouth glass jar	Cool, 4°C	48 hours
Radionuclides	1 x 8 oz wide-mouth glass jar	None	45 days

a Holding time for mercury is 28 days.

analytical records and reports. Specific guidance defining the necessary sample control, identification, and chain-of-custody documentation is discussed in EMD OPS FO.13.

7.6 DATA MANAGEMENT AND REPORTING PROCEDURES

Field data will be input to the RFEDS using a remote data entry module supplied by EG&G Rocky Flats. Data will be entered on a timely basis, and a 3.5-inch computer diskette will be delivered to EG&G Rocky Flats. A hard copy report will be generated from the module for contractor use. The data will undergo a prescribed QC process based on EMD OPS FO.14.

A sample tracking spreadsheet will be maintained by the contractor for use in tracking sample collection and shipment. EG&G Rocky Flats will supply the spreadsheet format and will stipulate timely reporting of information. These data will also be delivered to EG&G Rocky Flats on 3.5-inch computer diskettes. Computer hardware and software requirements for contractors using government-supplied equipment will be supplied by EG&G Rocky Flats. Computer and data security measures will also follow procedures outlined by EG&G Rocky Flats.

7.7 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the ER Program Project Manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. Table 7-6 provides the frequency with which QC samples will be collected and analyzed.

Duplicate samples will be collected by the sampling team for use as a relative measure of the precision of the sample collection process. These samples will be collected at the same time,

Sample Type	Type of Analysis	Media: Solids	Media: Liquids
Duplicates	Organics	1/10	1/10
	Inorganics	1/10	1/10
	Radionuclides	1/10	1/10
Field Preservation Blanks	Organics	NA	NA
	Inorganics	NA	1/20
	Radionuclides	NA	1/20
Equipment Blanks	Organics	1/20	1/20
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Trip Blanks	Organics	1/20	1/20
	Inorganics	NR	NR
	Radionuclides	NR	NR

NA = Not Applicable
NR = Not Required
1/10 = one QC sampler per ten samples collected

using the same procedures and equipment, and in the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field preservation blanks of distilled water, preserved according to the preservation requirements (Section 7.5.3), will be prepared by the sampling team and will be used to provide an indication of any contamination introduced during field sample preparation. These QC samples are applicable only to samples requiring chemical preservation (Table 7-6).

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on nondedicated sampling equipment. Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample containers. Equipment rinsate blanks are applicable to all analyses for water and soil samples (Table 7-6).

Trip blanks consisting of distilled water will be prepared by the laboratory technician and will accompany each shipment of water samples for volatile organic analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of volatile organics or any problems associated with sample shipment, handling, or storage. Information from the trip blanks will be used in conjunction with air monitoring data and other information to assess the influence of ongoing waste operations on the quality of data collected.

Procedures for monitoring field QC are provided in the RFP sitewide QAPjP.

8.0 BASELINE RISK ASSESSMENT PLAN

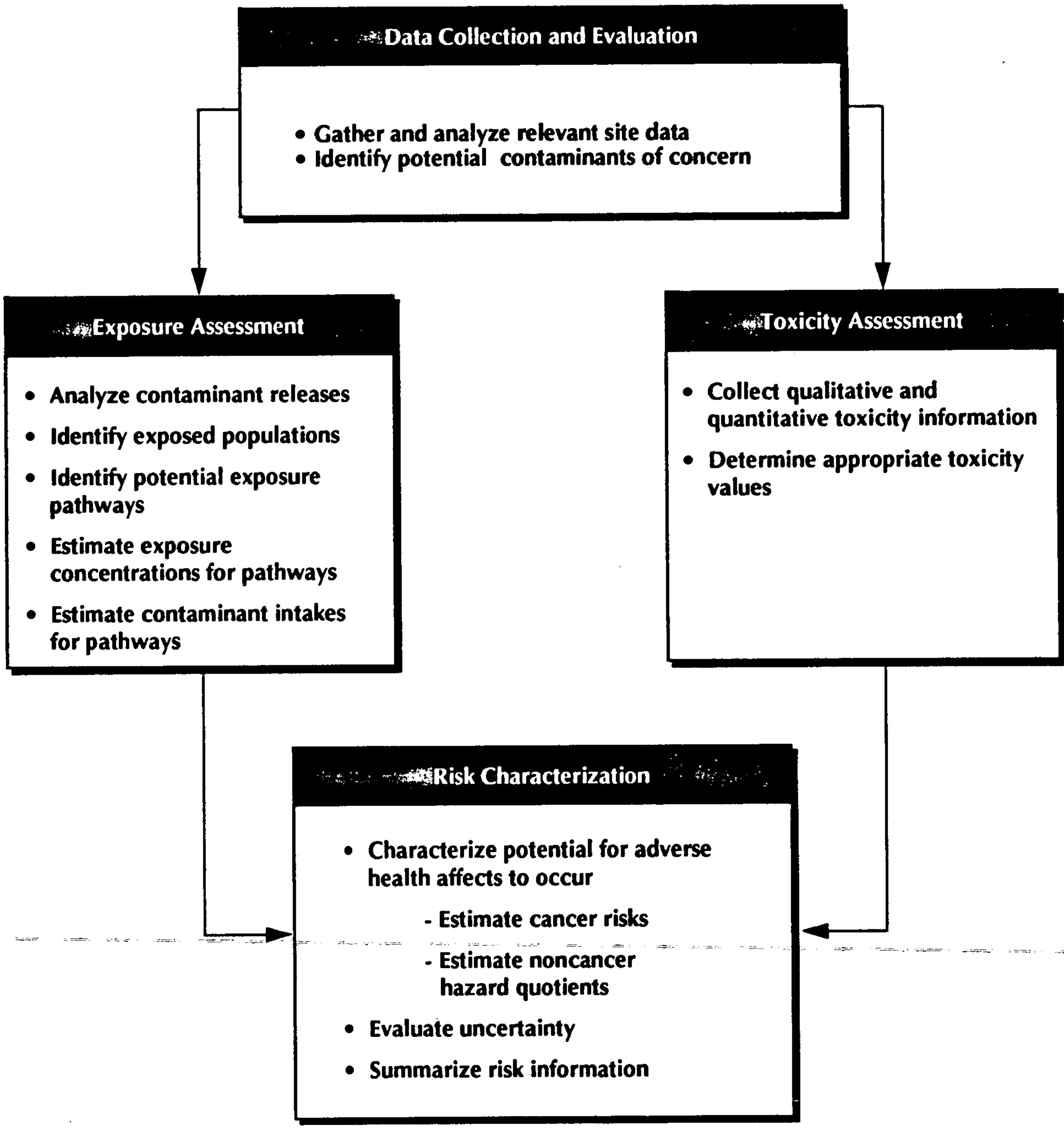
8.1 OVERVIEW

Section 300.430(d) of the National Contingency Plan (Federal Register, March 8, 1990, p. 8709) states that as part of the remedial investigation, a baseline risk assessment is to be conducted to determine whether contaminants of concern identified at the site pose a current or potential risk to human health in the absence of remedial action. This section describes the baseline risk assessment components which include:

- Data collection and analysis which includes identification and description of contaminants of concern (COCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis.

The environmental evaluation (Section 9.0) determines whether COCs identified at the site pose a risk to environmental receptors. Figure 8.1-1 illustrates the basic baseline risk assessment process and components. The baseline risk assessment objective is to identify and assess potential human health risks resulting from exposure to site contaminants present in various environmental media. Several objectives will be accomplished under the baseline risk assessment task, including identification and characterization of the following:

- Toxicity and levels of hazardous and radioactive contaminants present in relevant media (e.g., air, groundwater, soil, surface water, sediment, and biota)



U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

Figure 8.1-1

BASELINE RISK ASSESSMENT DEVELOPMENT PROCESS

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- Environmental fate and transport mechanisms within specific environmental media and cross-media fate and transport where appropriate

- Potential human and environmental receptors

- Potential exposure routes and extent of actual or expected exposure

- Extent of expected impact or threat and the likelihood of such impact or threat occurring (i.e., risk characterization)

- Level(s) of uncertainty associated with the above.

As this is a Phase I RFI/RI, insufficient data may be generated to fully evaluate contamination in media other than soils and environmental fate and transport mechanisms may not be fully characterized until Phase II.

To ensure acceptance of the human health risk assessment, four technical memorandum will be prepared for review and approval. These memorandum will outline how the most crucial steps in the risk assessment will be performed and address the following:

- Contaminants of concern
- Exposure scenerios
- Fate and transport models
- Toxicity values.

The baseline risk assessment will address the potential public health and impacts associated with the site under the no action alternative (no remedial action taken). This assessment will aid in the selection of site remedies based on the COCs and the environmental media associated with potential risks to human health.

The baseline risk assessment for OU10 will be performed in accordance with EPA and other guidance documents (Table 8-1). These documents are the most recent EPA guidance for human health risk assessments. EPA manuals are provided as guidance only; professional judgment is used in applying the information presented in these documents.

8.2 DATA COLLECTION AND EVALUATION

The objectives of data collection and evaluation are to gather and analyze all OU10 data relevant to the human health evaluation and to identify potential COCs at the site that are the focus of the risk assessment process (EPA, 1989b). Previous site investigations characterizing aspects of RFP and the surrounding area have been performed. Additional sampling and analysis of various media is planned to support the baseline risk assessment, the environmental assessment, and to further characterize the site. Environmental sampling and analysis will be conducted in accordance with the QAPjP and QAA. Once all necessary data has been collected and evaluated, reduction in the number of chemical and radiological contaminants identified to a list of COCs will be evaluated in accordance with EPA guidance (EPA, 1989b).

According to EPA (1989b), the data collection and evaluation task of the baseline risk assessment generally includes the following actions:

Data Collection:

- Review all available site information existing at start of the Phase I RFI/RI to determine basic site characteristics, identify potential exposure pathways and points, and help determine data needs (including modeling needs)

- Address modeling parameter needs to ensure that the data requirements for contaminant release, transport, and fate models are incorporated into data collection requirements

- Define background sampling needs to distinguish site-related contamination from naturally occurring or other nonsite-related levels of chemicals

Table 8-1 EPA Guidance Documents for Use in Development of the Baseline Risk Assessment

- EPAs Integrated Risk Information System (IRIS) - Office of Research and Development (continuously updated). Agency's primary source of chemical-specific toxicity and risk assessment information. Includes narrative discussion of toxicity database quality and explains derivation of Reference Doses, cancer potency factors, and other key dose response parameters. IRIS presents information that updates data originally presented in Exhibits A-4 and A-6 of the SPHEM (see below). Further information: IRIS Users Support, 513-569-7254 (EPA, 1987).

- Health Effects Assessment Summary Tables (HEAST) - Office of Research and Development/Office of Emergency and Remedial Response (updated quarterly). Because the IRIS chemical universe (while growing) is currently incomplete, the HEAST has been produced to serve as a "pointer" system to identify current literature and toxicity information on important non-IRIS chemicals. While HEAST data in some cases may be "agency-verified," the information is considered valuable for Superfund risk assessment purposes. Available from Superfund docket, 202-382-3046 (EPA, updated quarterly).

- Risk Assessment Guidance for Superfund, Human Health Evaluation Manual Part A, Interim Final - Office of Emergency and Remedial Response. This volume provides updated risk assessment procedures and policies, specific equations, and variable values for estimating exposure, and a hierarchy of toxicity data sources. There is an expanded chapter on risk characterization to help summarize information for the decision makers and detailed descriptions of uncertainties in risk assessment (EPA, 1989b).

- OSWER Directive on Soil Ingestion Rates - Office of Solid Waste and Emergency Response (January 1989), OSWER Directive #9850.4. Recommends soil investigation rates for use in risk assessment when site-specific information is not available. Available from Darlene Williams, 202-475-9810 (EPA, 1989a).

- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference - Office of Solid Waste and Emergency Response EPA 600-3/89/013. This report is a field and laboratory reference document that provides guidance on designing, implementing, and interpreting ecological assessments of hazardous waste sites. It includes sections on ecological endpoints, field sampling design, QA, aquatic and terrestrial toxicity and field survey methods, recommended biomarkers, and data analysis (EPA, 1989c).

- Risk Assessment Guidance for Superfund - Environmental Evaluation Manual, Interim Final (RAGS-EEM) - Office of Emergency and Remedial Response (March 1989), EPA/540/1-89/001A. Provides program guidance to help remedial project managers and on-scene coordinators manage ecological assessment at Superfund sites (EPA, 1989d).

Table 8-1 EPA Guidance Documents for Use in Development of the Baseline Risk Assessment

- Exposure Factors Handbook - Office of Research and Development (March 1989), EPA/600/8-89/043. Provides statistical data on the various factors used in assessing exposure; recommends specific default values to be used when site-specific data are not available for certain exposure scenarios. Further information: Exposure Methods Branch, 202-382-5988 (EPA, 1989c).

- Superfund Risk Assessment Information Directory (RAID) - Office of Emergency and Remedial Response (November 1986), EPA/540/1-86/061. Describes sources of information useful in conducting risk assessments. Currently under revision.*

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Office of Emergency and Remedial Response EPA/540/G-89/004. this guidance document is a revision of the EPA 1985 guidance. It describes general procedures for conducting an RI/FS (EPA, 1988).

- Superfund Exposure Assessment Manual (SEAM) - Office of Emergency and Remedial Response (April 1988), EPA/540/1-88/001. Provides a framework for the assessment of exposure to contaminants at or migrating from hazardous waste sites. Discusses modeling and monitoring (EPA, 1988b).

- CERCLA Compliance With Other Laws Manual - Office of Emergency and Remedial Response. The guidance is intended to assist in the selection of onsite remedial actions that meet the applicable or relevant and appropriate requirements (ARARs) of the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), and other federal and state environmental laws as required by CERCLA, Section 121 (EPA, 1988c).

- Guidance for Data Useability in Risk Assessment - Interim Final 1990. EPA/540/G-90/008.

- Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions - OSWER Directive 9355.0-30. April 22, 1991.

- Conduct a preliminary exposure assessment (identify media of concern, areas of concern, type of chemicals expected, and potential routes of contaminant transport) to collect information for the SAP

- Develop an overall strategy for sample collection to make sure data are appropriate for use in quantitative risk assessment

- Examine QA/QC measures (sampling protocol, sampling devices, QC samples, collection procedures, and sample preservation) important to risk assessment sampling

- Identify any special analytical needs based on review of existing information

- Take active role during work plan development and data collection to ensure risk assessment sampling needs are met.

<u>Data Evaluation</u>:

- Collect all data available from previous site investigations and RFI/RI to determine if previous data are suitable for combining into quantitative risk assessment

- Evaluate analytical methods to determine if analytical method results are appropriate for use in quantitative risk assessment

- Evaluate the quantitation and detection limits for all chemicals that may result in elimination of some chemicals from quantitative risk assessment

- Evaluate the quality of the data with respect to qualifiers and codes

- Evaluate quality of the data with respect to blanks to prevent the inclusion of nonsite-related contaminants in the risk assessment

- Evaluate Tentatively Identified Compounds (TICs) to determine if they should be included in risk assessment

- Compare potential site-related contamination with background to identify nonsite-related chemicals that are found at or near the site

- Identify potential COCs for use in the quantitative risk assessments.

Potential COCs may be identified based on the following considerations:

- The chemical is identified as a site-specific, waste activity related compound released from an identified source at the IHSS
- The concentration of the chemical exceeds the chemical-specific ARARs
- The chemical is detected at a frequency greater than 5 percent of the time in an individual media (e.g., surface soil, subsurface soil, alluvial groundwater, etc.)
- The concentration of the chemical exceeds the 95 percent Upper Tolerance Limit of the background concentration estimate
- The chemical is a potential carcinogenic compound classified as: Group A) sufficient evidence of carcinogenicity in humans; Group B1) limited evidence of carcinogenicity in humans; and Group B2) sufficient evidence in animals with adequate evidence in humans
- The occurrence of a non-carcinogenic compound in media at a concentration 0.1 times the Derived Media Concentration (DMC). (The DMC equals the exposure dose divided by the reference dose)
- The chemical's inter-media transport, persistence, and biometabolic characteristics
- The chemical's role as a nutrient.

8.3 EXPOSURE ASSESSMENT

Exposure is the contact of an organism (humans, in the case of a health risk assessment) with a chemical or physical agent (EPA, 1988b). This includes external exposure to radionuclides. Exposure is measured or estimated by the physical amount of a given contaminant present at either the lungs, intestines, or skin. Exposure occurs when a contaminant has migrated from the site location to a receptor point.

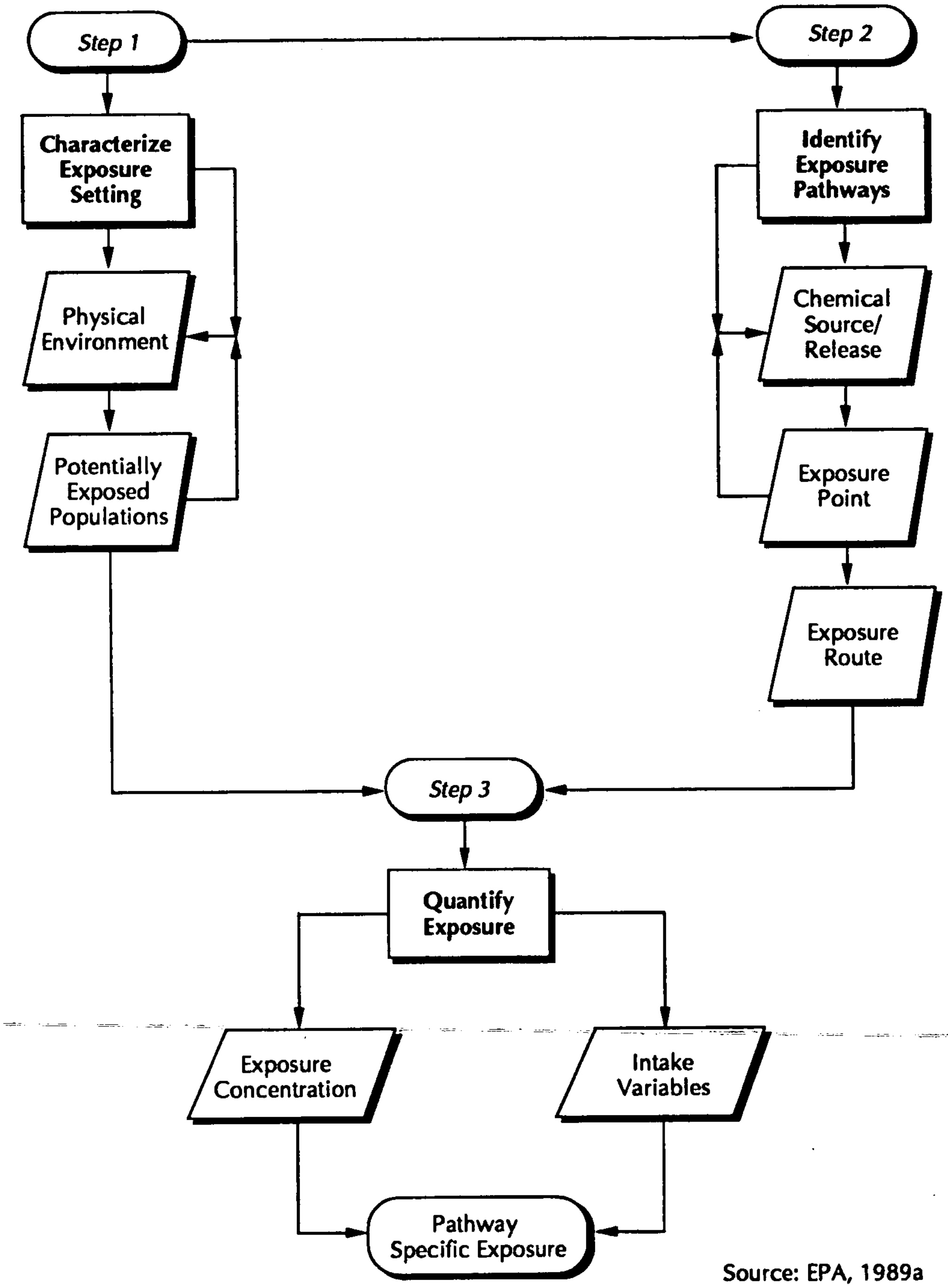
The objectives of the exposure assessment are to identify actual or potential chemical and radiological exposure pathways, characterize potentially exposed populations, and determine the extent of exposure (quantitatively or qualitatively) (EPA, 1988a).

The exposure assessment will be conducted per guidance provided in the Superfund Exposure Assessment Manual (EPA, 1988b). Figure 8.3-1 shows the steps involved in the exposure assessment. The exposure assessment process includes the following actions:

- Analyze the probable fate and transport of compounds for both present and future uses
- Identify the human populations in the area, typical activities that would influence exposure, and sensitive population subgroups
- Identify potential exposure pathways under current and future land use conditions
- Develop exposure scenarios for each identified pathway and select those scenarios that are plausible
- Identify exposure scenarios assuming both existing and potential future uses
- Identify the exposure parameters to be used in assessing the risk for all scenarios
- Develop an estimate of the expected exposure levels from the potential release of and/or exposure to contaminants.

An exposure pathway is comprised of the following elements:

- A source and mechanism of radioisotope and chemical release to the environment
- An environmental transport medium (e.g., air, groundwater) for the released constituent
- A point of potential contact for humans or biota with the affected medium (i.e., the exposure point)
- An exposure route (i.e., inhalation of contaminated dust) at the exposure point.



Source: EPA, 1989a

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Figure 8.3-1

EXPOSURE ASSESSMENT PROCESS

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Appropriate exposure scenarios will be identified for the site. Scenarios that could potentially be considered include residential, commercial/industrial, recreational, agricultural, and/or ecological research use. Factors to be examined in the pathway and receptor identification process are discussed below.

8.3.1 <u>Site Conceptual Model</u>

The site conceptual model for OU10 will be used to evaluate primary and secondary contaminant sources, release mechanisms, contaminant migration pathways, potential receptors, and associated exposures (EPA, 1988a). The exposure pathways relative to contaminant fate and transport mechanisms are characterized using the model. The site conceptual model for OU10 may be revised based on the results of the Phase I RFI/RI. Factors to be examined in the pathway and receptor evaluation process will include the following:

- Location of contaminant source
- Local topography
- Local meteorological data
- Local hydrogeology/surface water hydrology
- Surrounding land use
- Local water use
- Prediction of contaminant fate and migration
- Persistence and mobility of migrating contaminants.

For each migration pathway and for current and future conditions, receptors will be identified and characterized. Potential receptors will be defined by the appropriate exposure scenarios.

The potential level of human exposure to the COCs must be determined to assess the potential adverse health effects associated with access to the site. The chemical intake for exposed populations will be calculated separately as will all exposure pathways for each chemical. Subsequently, the total chronic intake by each exposure pathway will be calculated by adding the chemical intakes from each pathway for each population group. Ingestion, inhalation, and dermal chronic exposures for each population group will be estimated separately. Exposure concentrations will be estimated using several reasonable exposure conditions to evaluate the range of potential exposure concentrations. The exposure assessment will use the estimated minimum, expected, and reasonable maximum exposure (RME) concentrations. The RME concentrations are defined as the 95th percent confidence limit on average, or the maximum reported concentration, whichever is lower. Depending on data quality and their appropriateness for grouping, data distribution will be used to determine the appropriateness of using geometric or arithmetic means to estimate RME concentrations.

8.3.2 Contaminant Fate and Transport

The site conceptual model identifies potential contaminant fate and transport mechanisms. These may include wind dispersion of contaminated soil and/or contaminant leaching to groundwater and/or surface water. Factors affecting contaminant migration include particle size distribution, soil moisture content, precipitation, infiltration, TOC content, soil pH, solubility, partitioning coefficient, vapor pressure, Henry's Law constant, and the bioconcentration factor. Evaluating these factors will assist in determining whether contaminants would be expected to migrate from the source location to potential receptors.

8.3.3 Potential Receptors

Exposure scenarios developed in the baseline risk assessment may include exposure to on-site workers, future human receptors within OU10, and off-site human receptors from potentially contaminated groundwater, surface water, and airborne soil particulates. Exposure scenarios will be selected according to the future land use assessment (e.g., residential, recreational, restricted access) for the site.

8.3.4 Exposure Pathways

Exposure pathway identification involves connecting the contaminant source with a transport mechanism, a point of human exposure, and a human uptake mechanism. Sources will be sites within OU10 that contain the identified COCs. Release mechanisms may include contaminated leachate from soils into either groundwater or surface runoff, airborne soil particulate transport, volatilization of organic compounds, and/or release of radioactive particles. Human exposure points will be identified during the site characterization. These human exposure points may be located on site or off site. Only complete exposure pathways will be evaluated in the risk assessment. A complete pathway is defined as one that contains each element as previously described; a missing element results in an incomplete pathway.

8.3.5 Exposure Point Concentrations

Concentration of COCs at an exposure point will be estimated using analytical results from the Phase I RFI/RI and available historical data. Models recommended by EPA and CDH may be used to evaluate the potential release and transport of contaminants. Other models may be used based on a performance evaluation with consideration given to site-specific characteristics.

Any models used and data generated through their use will be characterized by the estimated variance developed by an uncertainty analysis. Variance of model output will be reduced to the maximum practical extent. Other contributions of uncertainty to the risk assessment are the exposure factors used in estimating intake and toxicity parameters (i.e., reference dose and cancer slope factors) used to evaluate the effect of an acquired dose to humans. In addition, variance data is lacking for most chemical toxicity factors.

Exposure point concentrations will be estimated for minimum, expected, and reasonable maximum estimated exposure conditions. A goodness-of-fit analysis will be conducted to correctly identify the data distribution and the most appropriate measure of central tendency when appropriate. The reasonable maximum concentration will be the upper 95 percent confidence limit on the appropriate mean, or on maximum likelihood estimate. In calculating the media concentrations, censored data (e.g., data sets with missing values or nondetects) will be treated by appropriate methods such as those described in Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987).

8.3.6 Estimation of Intake

Chemical intakes will be estimated using available, region-specific exposure parameters. Contaminant exposure is normalized for time and for body weight, expressed as milligrams of contaminant per kilogram of body weight per day (mg/kg/day). Radionuclide intake is expressed as total picocuries (pCi). Factors used to estimate intake include exposure frequency, exposure duration, contact rate, chemical concentration, body weight, and average time. These factors are based on the types of exposure (e.g., residential or occupational, ingestion, or inhalation).

The RME and average exposure point concentrations are used with receptor activity patterns to estimate contaminant intake for each exposure pathway. The EPA requires using 95th percentile rates, 90th or 95th percentile values for exposure duration, and average values for parameters such as body weight. Different parameters are used for children, adult workers, and recreational user exposures based on information provided by EPA (EPA, 1989b). The averaging time for carcinogens and noncarcinogens differ.

Other standard intake rates established by EPA will be used, if appropriate, and include the following:

- Soil ingestion rates for children, ages 1 through 6
- Soil ingestion rates for all others (workers and residents more than 6 years of age)
- Inhalation rates based on activity levels.

Contaminant rates can also be estimated for dermal exposures. Dermal exposures provide the greatest degree of uncertainty when compared with ingestion and inhalation exposure rates. This uncertainty results form the lack of chemical-specific dermal permeability constants. Limited efforts will be directed toward quantification of dermal exposure as dermal risk is expected to be quite low relative to other exposure types. The estimated contaminant intake through dermal exposures will be compared to intake values calculated for ingestion as the basis for demonstrating the insignificance of dermal exposure relative to other routes of exposure.

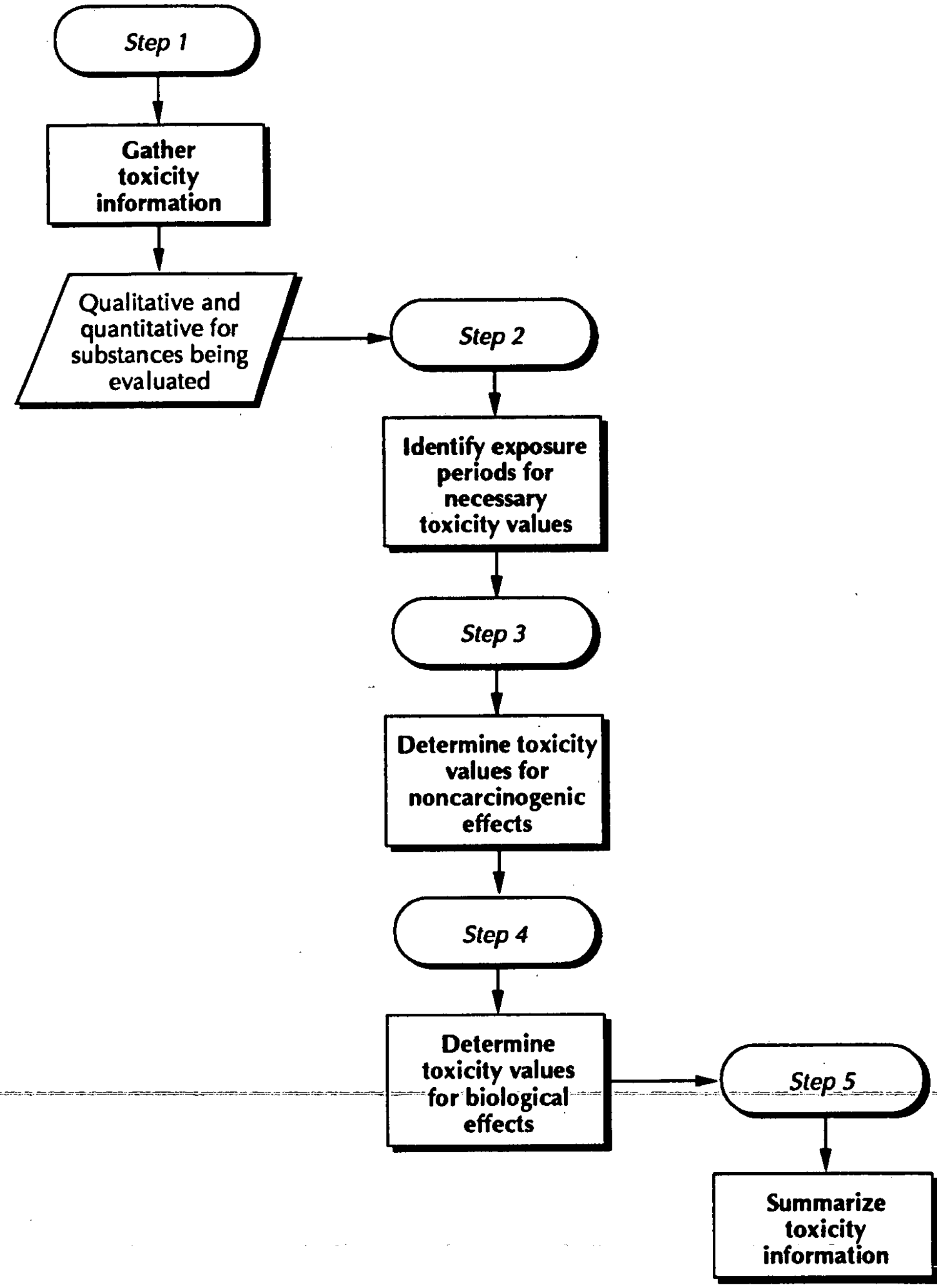
Human intake of COCs will be estimated using reasonable estimates of exposure parameters. EPA guidance, site-specific factors, and professional judgment will be applied in establishing exposure assumptions. Using reasonable risk estimates associated with the assumed exposure conditions results in evaluating risk without underestimating the actual risk. Estimated cancer risks and hazard indices are obtained using the intake factor combined mathematically with exposure point concentrations and critical toxicity values.

A technical memorandum will be submitted to EPA and the State of Colorado for review and approval that describes the present, future, potential, and reasonable use exposure scenarios along with a description of the assumptions made and the use of data. This memorandum will be submitted prior to the required submittal of the baseline risk assessment for OU10. In addition, a description of the fate and transport models that will be used, including a summary of the data that will be used with these models, will be submitted. Representative data will be used and the limitations, assumptions, and uncertainties associated with the models will be documented (DOE, 1991).

8.4 TOXICITY ASSESSMENT

Toxicity assessment, as part of the Superfund baseline risk assessment process considers (1) the types of adverse health or environmental effects associated with individual and multiple chemical and radiological exposures; (2) the relationship between the magnitude of exposures and adverse effects; and (3) the related uncertainties such as the weight of evidence for a contaminant's potential carcinogenicity in humans (EPA, 1988a).

EPA provides detailed guidance on performing toxicity assessment for both chemical and radioactive contaminants (EPA, 1989b). Figure 8.4-1 shows the steps of a toxicity assessment. In accordance with EPA's risk assessment guidelines, the projected concentrations of COCs at exposure points will be compared with ARARs to judge the degree and extent of risk to human health and the environment (including plants, animals, and ecosystems). Because many ARARs do not exist for certain media (such as soils), nor are all ARARs necessarily health based, this



Source: EPA, 1989a

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Figure 8.4-1

TOXICITY ASSESSMENT PROCESS

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comparison is not sufficient in itself to satisfy the requirements of the risk assessment process. Moreover, receptors may be exposed to contaminants from more than one medium. As a result, total doses to receptors might exceed risk reference doses (RfDs) and/or might result in an excess cancer risk greater than an acceptable target risk, as defined by EPA (e.g., 10^{-6} to 10^{-4}). Nevertheless, the comparison with standards and criteria is useful in defining the exceedance of institutional requirements. Aside from ARARs, the following criteria will be examined:

- Drinking water health advisories
- Ambient water quality criteria for protection of human health
- Center for Disease Control and Agency for Toxic Substances and Disease Registry soil advisories
- National Ambient Air Quality Standards.

Toxicity depends on the dose or concentration of the substance (dose-response relationship). Toxicity values are a quantitative expression of the dose-response relationship for a contaminant and take the form of RfDs and cancer slope factors, both of which are specific to exposure via different routes.

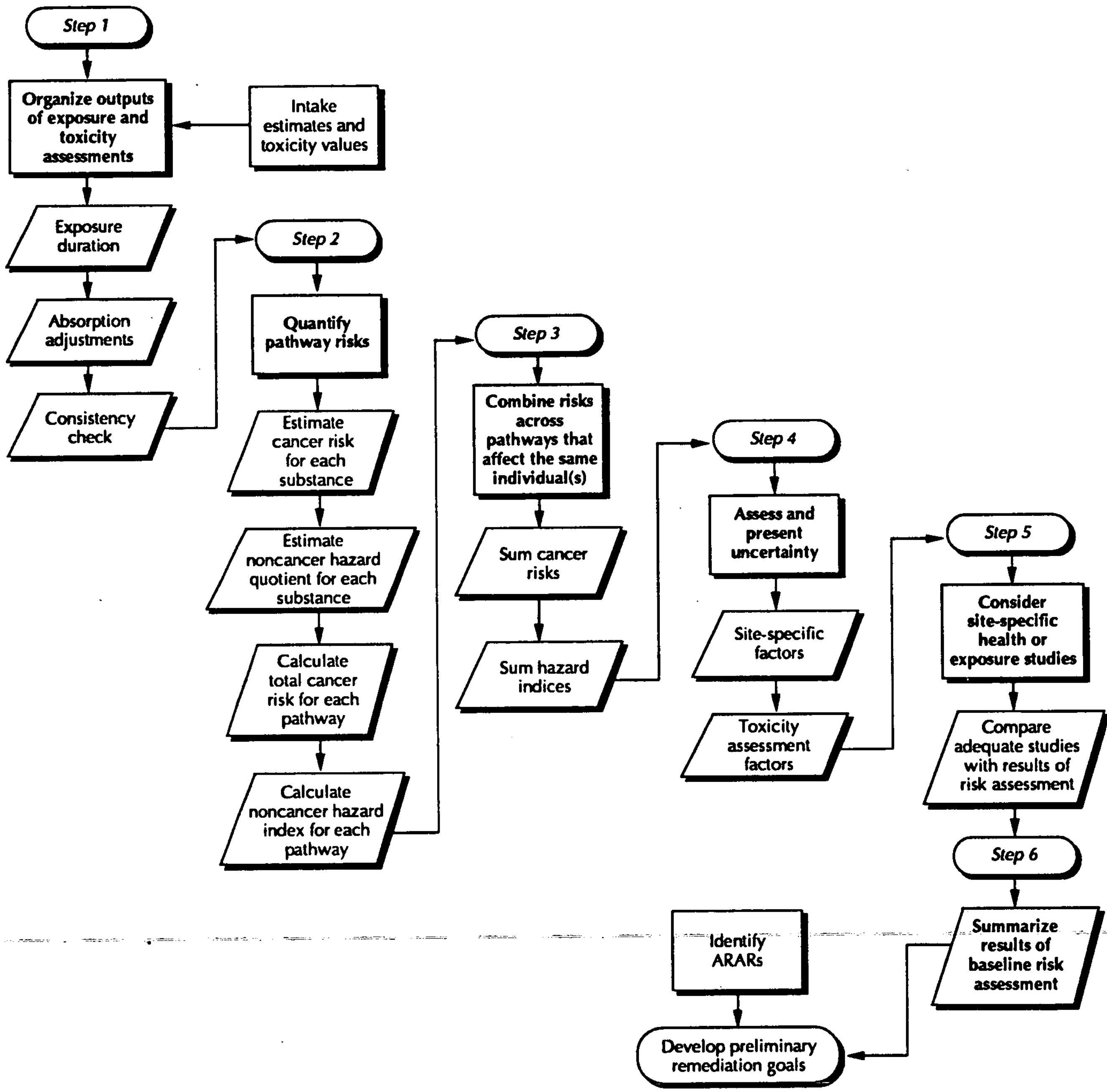
Two sources of toxicity values are currently available for chemicals and radionuclides. The primary source is EPA's Integrated Risk Information System (IRIS) database. IRIS contains up-to-date health risk and regulatory information and only those RfDs and slope factors that have been verified by EPA. IRIS is considered by EPA to be the preferred source of toxicity information for chemicals.

Following IRIS, the most recently available Health Affects Summary Tables (HEAST), issued by the EPA's Office of Research and Development, will be consulted to identify interim RfDs and slope factors for radionuclides.

In addition to identifying appropriate toxicity values, this section of the baseline risk assessment will provide brief toxicity profiles based on recent, published literature for each contaminant evaluated in the baseline risk assessment. These profiles will describe the acute, chronic, and carcinogenic health effects associated with site-related contaminants identified at OU10. The quality of these studies and their usefulness in estimating human health risks will be described. A more detailed explanation of the toxic effects of target chemicals will be provided in appendices to the baseline risk assessment and the environmental evaluation. Toxicity reference values will also be summarized. For the baseline risk assessment, this will include a brief description of the studies upon which selected reference values were based, the uncertainty factors used to calculate RfDs, and the EPA weight-of-evidence classification for carcinogens. For chemicals without EPA toxicity reference values, a literature search, including computer databases, will be conducted for selected compounds. A toxicity value will then (if possible) be derived from this information.

8.5 RISK CHARACTERIZATION

Risk characterization involves integrating radiological and chemical exposure and toxicity assessment information to quantitatively and qualitatively estimate the risk of adverse health effects. Risk characterization will be performed in accordance with EPA guidance (EPA, 1989b). Figure 8.5-1 shows the Risk Characterization Process.



Source: EPA, 1989b

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Figure 8.5-1

RISK CHARACTERIZATION PROCESS

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Noncarcinogenic risk will be evaluated by comparing the estimated daily intake of a contaminant at an exposure point to its RfD. This comparison measures the potential for noncarcinogenic health effects given the chemical intake factors used to estimate exposure. To assess the potential for noncancer effects posed by multiple chemicals, EPA's hazard index approach will be used. This method assumes dose additivity. Hazard quotients (individual chemical intake divided by the chemical RfD) are summed to provide a hazard index, and if the index exceeds 1, a potential for health risk is suggested. If a hazard index exceeds 1, where possible, chemicals may be segregated by similar effect or target organ to determine the potential health risks. Separate hazard indices may be derived for each effect if sufficient information or target organ specificity is available.

The potential for carcinogenic effects will be quantified by calculating excess lifetime cancer risks from the lifetime average exposure and cancer slope factor. These will be upper bound estimates because methods used to estimate slope factors are regarded as upper bounds on potential cancer risks rather than accurate representations of true cancer risk.

Both cancer and noncancer risks will be estimated by using RME and average contaminant intake values combined with exposure assumptions. This allows risk ranges to be considered (rather than a single value) and more closely considers the uncertainty associated with the estimates. In addition, risks may be added across exposure routes to assess the potential for additive affects.

Not all contaminants at OU10 will have toxicity values, thereby limiting the ability to develop quantitative estimates of risk. Where adequate toxicity values cannot be identified, potential risks associated with exposure to those constituents will be dealt with qualitatively.

8.6 UNCERTAINTY ANALYSIS

Uncertainty analysis is often viewed as the last step in the risk characterization process; however, uncertainty analysis is an essential component of each task in the baseline risk assessment process (EPA, 1990). The numbers and kinds of uncertainties identified in the baseline risk assessment directly impact the interpretation of estimated risks developed in the exposure scenarios. Quantitative risk estimates derived in risk assessments are conditional estimates that include numerous assumptions about exposure and toxicity. An uncertainty analysis will be performed to identify and evaluate nonsite and site-specific factors that may produce uncertainty in the risk assessment, i.e., assumptions inherent in the development of toxicological endpoints (potency factors, RfD) and assumptions considered in the exposure assessment (model input variability, population dynamics). Statistical sampling techniques (i.e., Monte-Carlo) may be employed for contaminants for which quantitative evaluation is not possible. The goal of this task will be to quantify, to the extent practicable, the magnitude and extent of uncertainty propagated through the risk assessment process. The uncertainty analysis will present the spectrum of potential risks under specified scenarios such that the risk management decision maker can obtain an understanding of the level of confidence associated with all estimates of potential human health risk.

9.0 ENVIRONMENTAL EVALUATION WORK PLAN

9.1 INTRODUCTION

The objective of this Environmental Evaluation (EE) Work Plan is to provide a framework for addressing and quantifying the ecological effects to the biotic environment (plants, animals, microorganisms) from exposure to contaminants from the 16 IHSSs comprising OU10. The EE follows the ten-task approach developed for RFP OUs (Section 9.1.1, Figure 9.1-1). During the process of scoping, Task 1 was completed, and many of the activities in Tasks 2 and 3 were completed as well. It was determined during scoping that the remaining seven tasks would be implemented with a reduced scope due to the developed and disturbed nature of the OU10 IHSSs and the Phase I status of this RFI/RI program. Other extended natural areas potentially impacted by OU10 will be investigated by RFI/RI programs for other OUs. Figure 9.1-2 shows how OU10 interfaces geographically with other OUs. Data will be shared among programs as appropriate.

The remaining OU10 EE investigations will be performed in cooperation with the ongoing study of abiotic media and in conjunction with the baseline risk assessment for OU10. Where appropriate, any further criteria necessary for performing the EE will be developed in conjunction with EEs and baseline risk assessments for all RFP OUs. Information from the EE will assist in determining the form, feasibility, and extent of remediation necessary for OU10 in accordance with RCRA and CERCLA.

This plan is prepared in conformance with the requirements of current applicable legislation, including CERCLA, as amended by SARA, and follows the guidance for such studies as provided in the NCP and EPA documents for the conduct of RCRA RFI/RI activities. Specifically, the

EPA guidance provided in the Risk Assessment Guidance for Superfund, Vol. II, EE Manual (EPA, 1989a) is followed. Additional guidance is derived from EPA's Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document (EPA, 1989b) and other guidance documents (Table 9-1). Although a formal Natural Resource Damage Assessment (NRDA) process has not been initiated at RFP, this work plan was also designed to be consistent with the NRDA process to the maximum extent possible.

9.1.1 Approach

The approach presented in this work plan is adapted from the toxicity-based approach to the assessment of ecological effects (EPA, 1989a, 1989b). Uncertainties concerning potential ecological effects are explicitly recognized and, where possible, quantified. To the greatest extent possible, objective estimates of ecological condition and of any firm, causal relationships between contamination and ecological condition are provided. However, this work plan is designed to provide a focused investigation of present or potential future contaminant effects on biota. Its scope is in concert with the ecologically depauperate nature of the IHSSs comprising OU10.

Three types of information are used to evaluate ecological condition and its relationship to contamination. Having all three types of data aids in identifying potential causes of the observed effects on biota that are related to the presence of contamination, rather than to other factors such as habitat alterations and natural variability. These three types of information are:

- Chemical — Chemical analyses of abiotic media provide information on the presence, concentrations, and variabilities of specific toxic compounds
- Ecological — Ecological surveys characterize the condition of existing communities and establish whether any adverse effects have occurred

Table 9-1 Examples of EPA and DOE Guidance Documents and References for Conducting Environmental Evaluations

Barnthouse, L.W., G.W. Suter, S.M. Bartell, J.J. Beauchamp, R.H. Gardener, E. Linder, R.V. O'Neill, and A.E. Rosen. 1986. User's Manual for Ecological Risk Assessment. Environmental Sciences Division. Publication No. 2679, ORNO-6251.

U.S. DOE. 1988. Comprehensive Environmental Response, Compensation, and Liability Act Requirements. DOE Order 5400.YY. Draft, September, 1988.

U.S. DOE. 1988. Radiation Effluent Monitoring and Environmental Surveillance. DOE Order 5400.XT, Draft, September, 1988.

U.S. DOE. 1990. Radiation Protection of the Public and the Environment. DOE Order 5400.5.

U.S. EPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. Interim Final. Office of Emergency and Remedial Response, Washington, D.C., EPA/540/g-89/004.

U.S. EPA. 1988. Superfund Exposure Assessment Manual. Office of Emergency and Remedial Response. Washington, D.C. EPA/540/1-88/001.

U.S. EPA. 1988. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites. Office of Emergency and Remedial Response. Washington, D.C. EPA/540/2-88/003.

U.S. EPA. 1989. Risk Assessment Guidance for Superfund Volume II Environmental Evaluation Manual. Interim Final. Office of Emergency and Remedial Response. Washington, D.C. EPA/540/189/001.

U.S. EPA. 1989. Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference Document. Office of Research and Development. EPA/600/3-89/013.

U.S. EPA. 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment. Washington, D.C. EPA/600/889/043.

U.S. EPA. 1990. Guidance for Data Useability in Risk Assessment. Office of Emergency and Remedial Response. Washington, D.C. EPA/540/G-90/003.9.2.1 Task 1: Preliminary Planning.

- Toxicological — Toxicological and ecotoxicological tests establish whether contaminants have been accumulated by biological tissue or are present in abiotic test media in sufficient concentrations to cause acute effects on biota.

The collection of these types of information and each task of the EE are coordinated with RFI/RI activities at nearby OUs (Figure 9.1-2) in order to avoid unnecessary duplication of effort and resources.

9.1.1.1 Task 1: Preliminary Planning

Task 1 focuses on the planning and coordination of the studies OU with data from other ongoing programs. It includes a determination of the scope of work and a definition of the study area. The DQO process is initiated in Task 1 according to EPA guidance (EPA, 1989b), and procedures for monitoring and controlling data quality to the extent possible are specified. This task is completed during work plan scoping.

9.1.1.2 Task 2: Data Collection/Evaluation and Conceptual Model Development

Task 2 includes a review, evaluation, and summary of available chemical and ecological data and identification of data gaps. Based on a preliminary review of these data, preliminary COCs, key receptor species, and reference areas are identified early in this task. Depending on the phase of the RFI/RI program and the sufficiency of the data available, final COCs, target biota taxa and reference areas may be identified as well. Such final decisions cannot typically be made this early during Phase I RFI/RI programs. As part of conceptual environmental model development, a food web model may be constructed and preliminary exposure pathways may be identified as part of the decision process shown in Figure 9.1-3. Results of these activities are used to refine the ecological (Task 3) and ecotoxicological (Task 9) field investigation sampling designs. Task 2 is completed during work plan scoping when sufficient data make this feasible.

9.1.1.3 Task 3: Ecological Field Investigation

Task 3 includes preliminary field surveys and may include an ecological field inventory to characterize the OU biota and their trophic relationships and note locations of obvious zones of chemical contamination. If warranted by the site field inventories are conducted in spring, summer, fall, and winter to obtain appropriate quantitative data on community composition in terrestrial and aquatic habitats. Any samples collected as part of the activity are saved for tissue analyses where COCs have been identified and sampling protocols are in place. Task 3 also includes initial aquatic toxicity tests. All collected field data are reduced, evaluated, compared, and integrated into the existing database to update knowledge of site conditions. Reconnaissance level activities are completed during scoping of the work plan. More extensive studies are performed during work plan implementation.

9.1.1.4 Task 4: Toxicity Assessment

Task 4 entails compilation of toxicity literature and the toxicological assessment of potential adverse effects from COCs on target biota taxa. This task is performed in conjunction with Task 5.

9.1.1.5 Task 5: Exposure Assessment and Pathway Model

Task 5 entails assessment of the exposure sources, pathways, and receptors. If warranted, a site-specific pathway model is developed on the basis of the ecological field survey data. This exposure-receptor pathway model is used to evaluate the transport of contaminants to biological receptors. The pathway model is based on a conceptual pathways approach (Fordham and Reagan, 1991) and provides an initial determination of the movement and distribution of contaminants, likely interactions among ecosystem components, and expected ecological effects. This approach is coordinated with the efforts of investigators working in other OUs to avoid duplication of effort, collect comparable data, and provide a consistent assessment of contaminant effects.

9.1.1.6 Task 6: Preliminary Contamination Characterization

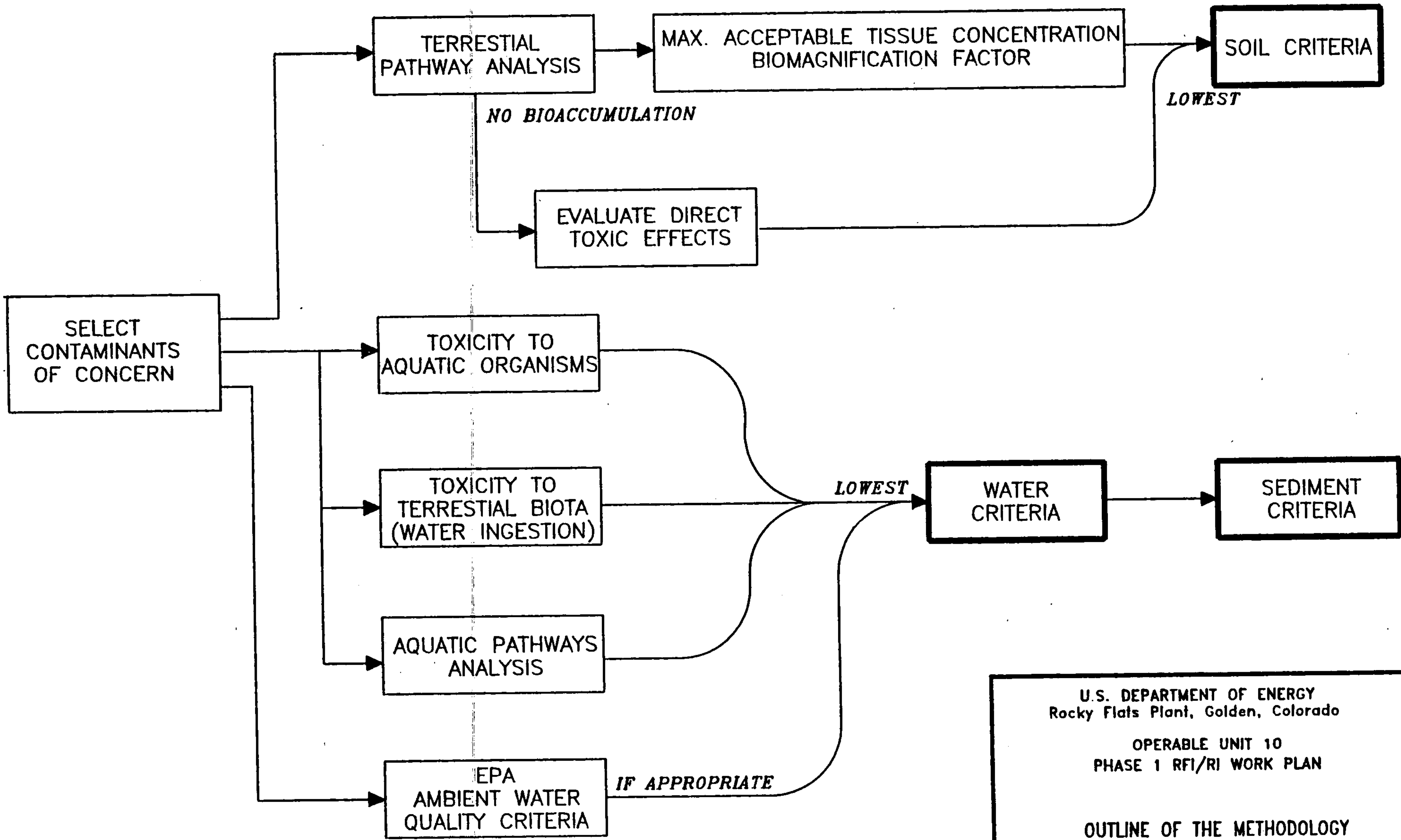
Task 6 provides a characterization of the threat or risk of OU contaminants to receptor populations and habitats. The actual or potential effects of contamination on ecological endpoints (e.g., species diversity, food web structure, productivity) and their magnitude are also addressed. Depending on DQOs that are developed in Task 1 and the quality of data collected, the contamination characterization may be expressed qualitatively, quantitatively, or as a combination of the two. Task 6 may include the preliminary derivation of remediation criteria. Development of these criteria entails consideration of federal and Colorado laws and regulations that are ARARs (see Section 3.0) and pertain to preservation and protection of natural biological resources. Information from ARARs, toxicological assessments, and the pathway model are used as shown in Figure 9.1-4 to develop criteria that address biological resource protection.

9.1.1.7 Task 7: Uncertainty Analysis

Task 7 includes the identification of assumptions and the evaluation of uncertainty in the environmental risk assessment analysis. Uncertainty may be presented qualitatively as a discussion of the unknowns identified in the risk analysis, or they may be quantified as a level of confidence in data selected from distributions. Task 7 may also include the identification of data needs to calibrate/validate the pathway model developed in Task 5.

9.1.1.8 Task 8: Planning

Task 8 entails the development of additional DQOs with respect to the conduct of Task 9, the ecotoxicological field investigation. DQOs to be achieved by such sampling are defined



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OPERABLE UNIT 10
PHASE 1 RFI/RI WORK PLAN

OUTLINE OF THE METHODOLOGY FOR DETERMINING CRITERIA FOR CONTAMINANTS OF CONCERN

FIGURE 9.1-4 OCTOBER 1991

according to EPA guidance (EPA, 1989b). Scoping and design of Task 9 field studies are based initially on the outcome of Tasks 1 through 3 and data from the ongoing abiotic program. Field sampling is performed in consideration of the acceptance criteria for demonstrating injury to a biological resource as defined by regulations under the Natural Resource Damage Assessment Rule [40 CFR Subtitle A Section 11.62 (f)] and the accompanying Type B Technical Information Document (DOI, 1987).

9.1.1.9 Task 9: Ecotoxicological Field Investigation

Task 9 includes tissue analysis studies and any additional ecotoxicological field investigations, which are based on results of the Task 2 preliminary toxicological assessment and the Task 3 ecological field investigation. Samples collected in Task 3 field studies are used wherever possible (e.g., when COCs have been identified and sampling protocols are in place); new samples are collected if necessary. The need for measuring additional population endpoints through reproductive success, enzyme inhibition, microbial respiration, or other ecotoxicological studies is evaluated based on the results of Tasks 4 through 7. Selection of the target analytes, species, and tissues is based on the determination of which contaminants are likely to be present in sufficient concentrations, quantities, and locations as to be detected in biota and be toxic to them. Identification of the specific selection criteria is in consultation with EPA and the State of Colorado. All necessary federal and state permits are obtained prior to any destructive sampling or collecting.

9.1.1.10 Task 10: Final Contamination Characterization and EE Report

Task 10 provides a final characterization of contamination in biota at OU10. Information on site environmental characteristics and contaminants, characterization of effects, remediation criteria, conclusions, uncertainty analysis, and limitations of the assessment are summarized into the EE

Report. Results from the Task 3 ecological field studies and the Task 9 ecotoxicological field investigations are used to evaluate ecosystem effects. These effects are considered as documented by current site-specific data and as they may be in the future as a result of changes through time.

Section 9.1.2 presents the results of implementing many of the activities in the first three tasks during scoping of this work plan. Section 9.2 presents any remaining activities to be completed under these tasks and provides the details of how the approach in each of the remaining seven tasks will be applied at OU10. Section 9.2.7 presents a suggested outline for the EE Report and Section 9.3 presents the field sampling plan. This plan addresses both the Task 3 ecological investigation and the Task 9 ecotoxicological field investigations.

9.1.2 Results of Scoping

9.1.2.1 Task 1: Preliminary Planning

In planning the OU10 EE and its coordination with other ongoing programs, several sources of pertinent information were located. EE data collection is currently underway at three OUs with proximity to some of the OU10 IHSSs (Figure 9.1-2): OU1 (881 Hillside) adjacent to IHSS 177, OU2 (903 Pad, Mound, and East Trenches Area) adjacent to IHSS 213, and OU5 (Woman Creek Drainage) downdrainage from OU1 and OU2. Data from OU6 (Walnut Creek) may be available in time for comparison with information from IHSSs 124, 124.1, 124.2, 124.3, 174, 176, 206, all of which are updrainage from Walnut Creek. Evaluation of data from these OUs may aid in understanding contaminant migration into or from OU10. IHSS 174 is surrounded by areas sampled under the wildlife/vegetation baseline study that may provide a basis for ecological comparison. The remaining IHSSs, while they may be updrainage or upwind from an operable unit or a sampled surface water station, are too surrounded by asphalt for them to have a reasonably identifiable connection with data from these locations.

In defining the study area (Task 110 as defined in Figure 9.1-1) and determining the scope of work (Task 120), a reconnaissance site visit was made to each of the 16 IHSSs. This site visit revealed that OU10 consists of highly disturbed and developed sites that are typically surrounded by other areas of disturbance and development. As a result, neither aquatic nor terrestrial ecosystems are well developed in OU10. In addition, the OU10 RFI/RI is a Phase I effort that has no validated data on abiotic media to provide information on the nature and extent of contaminants in those media. Therefore, while the ten-task EE process developed for RFP (Section 9.1.1) is being applied to OU10, it was determined appropriate to abbreviate many of the task components. Similarly, while sufficient data may be collected in selected areas to allow consideration of the potential for ecosystem impacts, an ecotoxicological approach is generally more appropriate given the site conditions and the stage of the RFI/RI study.

The data quality objectives (DQOs) for the OU10 EE as determined during scoping (Task 130) are:

- Describe the ecological setting of each of the IHSSs qualitatively or quantitatively, as appropriate to the ecological complexity of the IHSS
- Using the COC selection criteria and the list of OU10 contaminants identified during scoping and documented by the Phase I abiotic sampling program, define contaminants that are of concern to biota
- Evaluate the toxic effects of the COCs on biota taxa similar to those found at OU10
- Identify specific exposure points, transport media, and exposure point concentrations potentially available to biota

- Identify mechanisms and pathways for uptake of COCs by biota
- Determine whether there is evidence of contaminants in selected biota tissues collected within specific IHSSs or their zone of influence
- Characterize the adverse effects of COCs on biota and identify contaminant concentrations in abiotic media that would result in no such effects
- Evaluate the likelihood of impacts to individuals, populations, communities or ecosystems from contaminants identified in any abiotic media
- Summarize the assumptions, uncertainties, and qualifications appropriate to the overall process of exposure assessment and contamination characterization at this Phase I stage of the RFI/RI
- Determine whether there is a need for further ecological study or analysis of chemical impacts to biota at OU10
- Evaluate the need for remediation to protect the environment and describe the source and extent of any uncertainty in that evaluation.

Specific DQOs for particular sampling methodologies are provided in the FSP (Section 9.3).

Site-wide criteria for identifying COCs and key receptor species were reviewed with the ongoing Technical Working Group comprised of representatives from EG&G, DOE, and each of the regulatory review agencies. This group assures an integrated effort and provides a means for obtaining input from regulatory agencies throughout the preliminary planning and implementation tasks. Coordination with this group will continue throughout the OU10 EE. These criteria and the results of their application to OU10 during scoping are provided in Sections 9.1.2.2 and 9.1.2.3, respectively. Procedures for establishing reference areas and the development of the field sampling plan (FSP) were also discussed with the Technical Working Group. These procedures were finalized in SOP 5.13. Procedures for monitoring and controlling data quality were identified as those in the EG&G (1991c) Ecology Standard Operating Procedures (SOPs) and in the EG&G (1991d) Site-wide Quality Assurance Project Plan (QAPjP). The SOPs also provide the criteria for selection of reference areas, and taxon specific sampling approach and design. These criteria were reviewed in completion of Task 140.

There was also coordination with other activities ongoing for OU10 as well as with activities ongoing on other OUs as part of this preliminary planning effort (Tasks 150 and 160). This coordination resulted in the identification of data that can be shared with other OU10 RFI/RI activities. The information obtained is discussed in Section 9.1.2.2.

9.1.2.2 Task 2: Data Collection/Evaluation and Conceptual Model Development

As part of the scoping process required to prepare this work plan, a reconnaissance visit to each of the OU10 IHSSs was made and the Phase I RFI/RI Draft Work Plan for OU10 was reviewed. Several additional documents were reviewed in an assessment of available information. These included the Final Environmental Impact Statement (EIS), Rocky Flats Plant (DOE, 1980); Wetlands Assessment (EG&G, 1990a); Draft EE Work Plan for OU2 (in RFI/RI Work Plan, EG&G, 1991a); the Final Phase III RFI/RI Work Plan, 881 Hillside Area (DOE, 1990); Final EE Work Plan for OU5 (in RFI/RI Work Plan, EG&G, 1991a); and Phase I RFI/RI Draft Work Plan for OU3 [now 10] Other Outside Closures among others. Unpublished information resulting from ongoing programs to study site-wide baseline conditions and the operable units in the Woman Creek drainage was also considered. The information in these documents and resulting from implementation of the work plans provides a backdrop against which ecological and chemical data from OU10 may be better interpreted. Review of new site-specific data and of the literature will continue throughout the EE.

The literature review provided existing data on sampling and analysis pertinent to OU10. These data are summarized below in response to Task 210. The review of information also revealed that, due to the Phase I status of the OU10 RFI/RI, there are no validated analytical data on the contaminants detected at OU10 (Task 230). Data from other DOE CERCLA sites (Task 220) were briefly reviewed are incorporated into the discussion of OU10 contamination. A more detailed review may be performed after the Phase I program if sufficient information has been collected during the Phase I program to focus and warrant such an investigation.

Data identified in a review of other programs ongoing on RFP include information on air quality, soils, surface water, groundwater, and a terrestrial and aquatic biota. Air quality data from the site-wide air quality monitoring program at RFP data can be used to identify routes of airborne transport and deposition of contaminants to the food web. While these data are available as an aid in interpreting OU10 biota data, the scattered locations of the OU10 IHSSs and their interspersion with other plant site buildings and activities makes it unlikely that these data will be helpful. Few data exist on contaminants present in surficial materials at OU10. Previous investigations sampled surface water at IHSSs 213 and 214 and soil at IHSSs 129, 170, 174, 175, 176, 177, 182, 213, and 214. These data have not been validated, and there is some uncertainty in the unvalidated data. Therefore soil data from the Phase I RFI/RI program described in detail in Section 7.0 will need to be used. Surface water and sediment samples are collected on a regular basis as part of ongoing sitewide investigations. Any pertinent data from these sources will be reviewed and used in the analysis of data from the OU10 EE. Groundwater contamination is not considered relevant to the OU10 EE except as it becomes available to biota through surface water recharge. Date from any of the soil borings from the Phase I RFI/RI that are completed into shallow monitoring wells will be used to assess whether this exposure pathway is present. Terrestrial and aquatic species in the RFP area have been described by several researchers (Weber et al., 1974; Clark, 1977; Clark et al., 1980; Quick, 1964; Winsor, 1975; CDOW, 1981; CDOW, 1982a, 1982b); most of these reports are summarized in the Final EIS (DOE, 1980). In addition, terrestrial and aquatic radioecology studies conducted by Colorado State University (CSU) and DOE (Rockwell International, 1986; Paine, 1980; Johnson et al., 1974; Little, 1976; Hiatt, 1977), along with annual monitoring programs at RFP, have provided information on the plants and animals in the area and their relative distribution. Further, extensive data are currently being collected on vegetation and wildlife in property protection area (PPA) and in the OU1, OU2, and OU5 EE study areas.

Just as there is a lack of reliable IHSS-specific chemical data, there is no IHSS-specific information in the literature on the ecology of these sites. Therefore, the development of a conceptual model and a preliminary risk assessment (Task 240) were based on data collected during the reconnaissance site visit. However, information on a site-wide basis regarding protected wildlife, vegetation and habitats was identified during scoping and is presented below.

OU10 Contamination

As described in Section 2.1 of this report, a number of chemicals are suspected to be present in OU10 soils and surface water at levels above background. Table 9-2 summarizes these findings. However, investigations previous to this Phase I RFI/RI were not extensive, and were focused primarily on soils. As the number of blanks in Table 9-2 illustrates, many sites were analyzed only for selected chemicals or not analyzed at all. Further, data from previous studies were not validated, and many of the chemicals reported as detected were also detected in blanks and were present at concentrations estimated below detection level. Therefore, the site-specific information on chemicals found in this section and in Section 9.3 is preliminary. Note that the terms

Table 9-2 Chemicals Previously Reported at OU10 Above Background (Metals and Radionuclides) or Above Certified Reporting Levels (Organics and Inorganics)

CHEMICAL	IHSS 124.1 124.2 124.3	129	170	174	175	176	177	181	182
METALS	ND		ND					ND	
aluminum						so	so		so
arsenic				so		so			
barium				so			so		
beryllium				so					
cadmium		so		so	so	so	so		so
calcium					so	so	so		
copper		so		so	so	so	so		so
iron				so		so	so		so
lead		so		so	so	so	so		
magnesium					so	so	so		so
manganese				so		so			so
mercury		so			so	so	so		so
nickel						so			so
potassium				so	so	so	so		so
vanadium				so		so	so		so
zinc				so	so	so	so		so
RADIONUCLIDES	ND	ND	ND					ND	
gross alpha				so	so		so		
gross beta					so		so		
plutonium-239,-240				so	so	so	so		
Americium-241				so	so	so	so		
uranium-233,-234				so	so	so	so		so
uranium-238				so	so	so	so		so

IHSS 124.1, 124.2, 124.3 Radioactive Liquid Waste Storage Tanks
IHSS 129 Oil Leak
IHSS 170 P.U. & D. Storage Yard-Waste Spills
IHSS 174 P.U. & D. Continer Storage Facilities
IHSS 175 S & W Building 980 Container Storage Facility
IHSS 176 S & W Contractor Storage Yard
IHSS 177 Building 885 Drum Storage Area
IHSS 181 Building 334 Cargo Container Area
IHSS 182 Building 444/453 Drum Storage Area
so=soil
ND=No Data

Table 9-2 Chemicals Previously Reported at OU10 Above Background (Metals and Radionuclides) or Above Certified Reporting Levels (Organics and Inorganics)

CHEMICAL	IHSS 124.1 124.2 124.3	129	170	174	175	176	177	181	182
ORGANICS	ND		ND					ND	
acetone				so	so	so	so		so
benzene		so							
bis-(2-ethylhexyl)phthalate				so					
2-butanone		so					so		
4-chloro-3-methyl phenol				so					
ethylbenzene		so		so			so		so
fluoranthene									so
methylene chloride		so			so	so			
naphthalene									so
phenanthrene									so
pyrene		so							so
tetrachloroethene				so					
toluene		so							so
total xylenes		so							so
trans-1,2-dichloroethene							so		
1,1,1-trichloroethane		so		so					so
ANIONS									
nitrate/nitrite				so	so	so			
cyanide									

IHSS 124.1, 124.2, 124.3 Radioactive Liquid Waste Storage Tanks
IHSS 129 Oil Leak
IHSS 170 P.U. & D. Storage Yard-Waste Spills
IHSS 174 P.U. & D. Continer Storage Facilities
IHSS 175 S & W Building 980 Container Storage Facility
IHSS 176 S & W Contractor Storage Yard
IHSS 177 Building 885 Drum Storage Area
IHSS 181 Building 334 Cargo Container Area
IHSS 182 Building 444/453 Drum Storage Area
so=soil
ND=No Data

Table 9-2 Chemicals Previously Reported at OU10 Above Background (Metals and Radionuclides) or Above Certified Reporting Levels (Organics and Inorganics)

CHEMICAL	205	206	207	208	210	213	214
METALS	ND	ND	ND	ND	ND		
aluminum							
arsenic							
barium							
beryllium							
cadmium						sw	sw
calcium							
copper							
iron							
lead							
magnesium							
manganese							
mercury							
nickel							
potassium							
vanadium							
zinc							
RADIONUCLIDES	ND	ND	ND	ND	ND		
gross alpha						so	so
gross beta						so	so
plutonium-239,-240							
Americium-241							
uranium-233,-234							
uranium-238							

IHSS 205 Building 460 Sump #3 Acid Side
IHSS 206 Inactive D-836 Hazardous Waste Tank
IHSS 207 Inactive Building 444 Acid Dumpsters
IHSS 208 Inactive 444/447 Waste Storage Area
IHSS 210 Unit 16, Building 980 Cargo Container
IHSS 213 Unit 15, Pad Pondcrete Storage
IHSS 214 Unit 25, 750 Pad Pondcrete and Saltcrete Storage
sw=surface water
ND=No Data

CHEMICAL	205	206	207	208	210	213	214
ORGANICS	ND	ND	ND	ND	ND		
acetone							
benzene							
bis-(2-ethylhexyl)phthalate							
2-butanone							
4-chloro-3-methyl phenol							
ethylbenzene							
fluoranthene							
methylene chloride							
naphthalene							
phenanthrene							
pyrene							
tetrachloroethene							
toluene							
total xylenes							
trans-1,2-dichloroethene							
1,1,1-trichloroethane							
ANIONS							
nitrate/nitrite						sw	sw
cyanide						sw	sw

IHSS 205 Building 460 Sump #3 Acid Side
IHSS 206 Inactive D-836 Hazardous Waste Tank
IHSS 207 Inactive Building 444 Acid Dumpsters
IHSS 208 Inactive 444/447 Waste Storage Area
IHSS 210 Unit 16, Building 980 Cargo Container
IHSS 213 Unit 15, Pad Pondcrete Storage
IHSS 214 Unit 25, 750 Pad Pondcrete and Saltcrete Storage
sw=surface water
ND=No Data

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chemical and contaminant are used throughout Section 9.0 to denote elements, compounds, and radionuclides.

Preliminary reviews of available data show some organics to be present above detection limits in soil, inorganics to be present in surface water and soil, metals to be present in surface water and soil, and radionuclides to be present in soil (Table 9-2). Some of the chemicals are reported as having concentrations above background (metals, radionuclides), while organics and inorganics are reported if their concentrations are above detection limits. The validity of the levels reported is currently being evaluated as part of the RFI/RI effort. Tables 9-3 through 9-8 provide comparative criteria where available for the potential COCs, providing criteria specific for biota that are used in identifying COCs and also providing criteria for human health that are for comparative purposes only. Given that the detected concentrations of these chemicals are unvalidated, these tables list the detected chemicals without quantifying their maximum values. Most of the contaminants listed in Table 9-2 are likely to impact biota if present at sufficient concentrations. Forthcoming data from the Phase I RFI/RI sampling of abiotic media will be used to complete these tables prior to the Task 9 chemical analysis of biota tissue samples for specific contaminants. Thus, the Task 241 selection of COCs for biota cannot be completed at this time.

Metals

To date, the heavy metals reported in OU10 are: aluminum, arsenic, barium, beryllium, cadmium, calcium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, vanadium, and zinc. These have all been detected in soils. Cadmium, lead, mercury, and vanadium were detected at elevated levels at one or more IHSSs. Limited surface water and groundwater samples and few sediment samples have been collected at OU10. Cadmium was also detected above background in all surface water samples at IHSSs 213 and 214.

Table 9-3 Comparison of Maximum Soil and Sediment Values for Total Metals to Environmental Action Criteria-Other Outside Closures

Parameter	Soil & Sediment Environmental Action Criteria[1] (mg/kg)	Sediment Concentration[a] (mg/kg) (Sample #)	Soil: Rocky Flats Alluvium Concentration[a] (mg/kg) (Sample #) (depth - increment [ft])	Soil: Colluvium Concentration[a] (mg/kg) (Sample #) (depth - increment [ft])
Aluminum	30[2]			
Antimony	30			
Arsenic	--			
Barium	4,000			
Beryllium	0.143			
Cadmium	--			
Calcium	--			
Chromium	III-80,000			
Copper	IV-400[3]			
Cyanide	2,000			
Lead	--			
Magnesium	--			
Manganese	--			
Mercury	--			
Nickel	2,000			
Potassium	--			
Sodium	--			

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Table 9-3 Comparison of Maximum Soil and Sediment Values for Total Metals to Environmental Action Criteria-Other Outside Closures

Parameter	Soil & Sediment Environmental Action Criteria[1] (mg/kg)	Sediment Concentration[a] (mg/kg) (Sample #)	Soil: Rocky Flats Alluvium Concentration[a] (mg/kg) (Sample #) (depth - increment [ft])	Soil: Colluvium Concentration[a] (mg/kg) (Sample #) (depth - increment [ft])
Strontium	--			
Thallium	20-40[5]			
Vanadium	2,000[6]			
Zinc	20-4,000[7]			

1 Risk criteria are the lowest concentrations reported for Health-Based Criteria for Systematic Toxicants and Carcinogens (Tables 8-6 and 8-7 in EPA, 1989c) Criteria reported in Tables 8-6 and 8-7 (EPA, 1989b) are reduced by 100 to provide a safety factor to biota.
2 Criteria for aluminum phosphide.
3 Criteria for copper cyanide.
4 Criteria for potassium compounds.
5 Criteria range for thallium compounds.
6 Criteria for vanadium pentoxide.
7 Criteria range for zinc compounds.
a Metals listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.

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Table 9-4 Comparison of Maximum Surface Water Values for Metals to Federal and State Water Quality Standards (µg/l) - Other Outside Closures

			Federal Standards			State Standards			
			AWQC for Protection of Aquatic Life[b]			Biological Parameters for Aquatic Life[d]		Stream Segment Standard[e]	
Parameter	Maximum Value Reported[a]	Location[a]	Acute	Chronic	MCL[c]	Acute	Chronic	Acute	Chronic
Aluminum					.050[3]	950	150		
Antimony			9000[2]	1600[2]					
Arsenic[4]			360-III 850-V	190-III 48-V	0.050			50	
Barium					0.100				
Beryllium			130[2]	5.3[2]					
Cadmium			3.9[5]	1.1	0.010	TVS	TVS	TVS	TVS
Calcium									
Copper			18[5]	12[5]		TVS	TVS	TVS	TVS
Cyanide			22	5.2		5	5	5	5
Lead			82[5]	3.2[5]	0.50	TVS	TVS	TVS	TVS
Magnesium									
Manganese					0.50[3]				50

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Table 9-4 Comparison of Maximum Surface Water Values for Metals to Federal and State Water Quality Standards (µg/l) - Other Outside Closures

Parameter	Maximum Value Reported[a]	Location[a]	Federal Standards: AWQC for Protection of Aquatic Life[b]			State Standards: Biological Parameters for Aquatic Life[d]		State Standards: Stream Segment Standard[e]	
			Acute	Chronic	MCL[c]	Acute	Chronic	Acute	Chronic
Mercury			2.4	0.012	0.002			0.01	
Nickel			1400[5]	160[5]		TVS	TVS	TVS	TVS
Potassium									
Sodium									
Strontium									
Thallium			1400	40					
Vanadium									
Zinc			120[5]	110[5]	5000[3]	TVS	TVS	TVS	TVS

a Metals listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.

b EPA Quality Criteria for Protection of Aquatic Life, 1986.

c EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990).

d CDH/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974, amended 9/30/1989 (Environmental Reporter 726: 1001-1020: 6/1990).

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e CDH/WQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981, amended 2/15/1990.

AWQC = Ambient Water Quality Criteria
MCL = Maximum Contaminant Level
SDWA = Safe Drinking Water Act
TVS = Table Value Standard
WQCC = Water Quality Control Commission

1 SDWA - MCL from EPA National Primary and Secondary Drinking Water Regulations - 40 CFR Parts 141, 142, and 143; Final Rule Effective July 30, 1992.
2 Insufficient data to develop criteria; Lowest Observed Effects Level (LOEL).
3 Secondary MCL.
4 Standards given for arsenic(III) and arsenic(V); chromium(III) and chromium(VI).
5 Hardness dependent criteria.

Table 9-5 Summary of Maximum Total Radionuclide Values in Soils and Sediments - Other Outside Closures

Medium	Maximum Concentration (pCi/g)[1]	Sample #[1]	Depth Interval (ft)[1]
Gross alpha			
Gross beta			
Plutonium-239, -240			
Americium 241			
Uranium-233, -234			
Uranium-238			

1 Radionuclides listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.

Table 9-6 Comparison of Maximum Surface Water Values for Radionuclides to Federal and State Surface Water Quality Standards - Other Outside Closures

			Federal Standards	State Stream Classification Standards[b]	
Analyte	Dissolved Concentration (pCi/l)[a]	Total Concentration (pCi/l)[a]	SDWA Maximum Contaminant Level[a]	Basin Table D Radionuclide Standards	Table 2 - Radionuclide Standard for Woman Creek
Gross alpha			15 pCi/l		7 pCi/l
Gross beta			4 mrem/yr		5 pCi/l
Plutonium-239±240				15 pCi/l	
Americium-241				30 pCi/l	
Uranium-233, -234					
Uranium-238					

a Radionuclides listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.

b EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990).

c Colorado Department of Health/Water Quality Control Commission, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8), 4/6/1981; amended 2/15/1990.

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Table 9-7 Comparison of Maximum Surface Water Values for Organic Compounds to Federal and State Water Quality Standards - Other Outside Closures

Parameter	Maximum Value Reported Concentration[a]	Location	Federal Standards							
			SDWA Maximum Contaminant Level[a]	CWA AWQC for Protection of Aquatic Life[c]		CWA Water Quality Criteria for Protection of Human Health[c]		SDWA Maximum Contaminant Level Goal[b]	SDWA Maximum Contaminant Level BCs[d]	SDWA Maximum Contaminant Level Goal TBCs[d]
				Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only			
1-1-1,Trichloroethane										
2-Methylnaphthalene										
2-Butanone										
4-Chloro-3-methyl phenol										
Acenaphthene										
Acetone										
Anthracene										
Benzene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Benzo(f)fluoranthene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Benzoic acid										
Bis-(2-Ethylhexylphthalate)										

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Table 9-7 Comparison of Maximum Surface Water Values for Organic Compounds to Federal and State Water Quality Standards - Other Outside Closures

Parameter	Maximum Value Reported Concentration[a]	Location	Federal Standards							
			SDWA Maximum Contaminant Level[a]	CWA AWQC for Protection of Aquatic Life[c]		CWA Water Quality Criteria for Protection of Human Health[c]		SDWA Maximum Contaminant Level Goal[b]	SDWA Maximum Contaminant Level BCs[d]	SDWA Maximum Contaminant Level Goal TBCs[d]
				Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only			
Butyl benzyl phthalate										
Chlorobenzene										
Chloroform										
Chrysene										
di-n-butyl phthalate										
di-n-octyl phthalate										
Dibenz(a,h)anthracene										
Dibenzofuran										
Ethylbenzene										
Fluoranthene										
Fluorene										
Indeno(1,2,3-cd) pyrene										
Methylene chloride										
N-nitrosodiphenylamine										
Naphthalene										
Pentachlorophenol										

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Parameter	Maximum Value Reported Concentration[a]	Location	Federal Standards							
			SDWA Maximum Contaminant Level[a]	CWA AWQC for Protection of Aquatic Life[c]		CWA Water Quality Criteria for Protection of Human Health[c]		SDWA Maximum Contaminant Level Goal[b]	SDWA Maximum Contaminant Level BCs[d]	SDWA Maximum Contaminant Level Goal TBCs[d]
				Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only			
Phenanthrene										
Phenol										
Pyrene										
Tetrachloroethene			5.28 mg/l[1]	840 µg/l[1]	800 ng/l**	8.85 µg/l**				
Toluene			1 mg/l	17.5 mg/l[1]		14.3 mg/l	424 mg/l	1 mg/l		
Total Xylenes										
Trichlorofluoromethane										

1 Criteria not developed, value presented is lowest observed effects level (LOEL).
2 In the absence of specific numeric standards for non-naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/WQCC or EPA.
3 Table I - physical and biological parameters
Table II - inorganic parameters
Table III - metal parameters
Values in Tables I, II, and III for recreational uses, cold water biota and domestic water supply are not included.
4 All are 30-day standards except for nitrate and nitrite.

* Secondary maximum contaminant level
** Human health criteria for carcinogens reported for three risk levels. Value presented is the 10^{-5} risk level.

a Organics listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.
b EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990).
c EPA, Quality Criteria for Protection of Aquatic Life, 1986.
d EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, and 143, Final Rule, effective July 30, 1992.

e CDH/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/74; amended 9/30/89 (Environmental Reporter 726: 1001-1020:6/1990).

f CDH/WQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981, amended 2/15/1990.

AWQC = Ambient Water Quality Criteria
CDH = Colorado Department of Health
SDWA = Safe Drinking Water Act
TBC = To Be Considered
WQCC = Water Quality Control Commission

Table 9-8 Comparison of Maximum Soil and Sediment Values for Organic Compounds to Environmental Action Criteria - Other Outside Closures

Parameter	Soil and Sediment Environmental Action Criteria (mg/kg)[a]	Sediment Concentration (µg/kg)[b] (Sample #) (depth interval)	Soil	
			Rocky Flats Alluvium Concentration (µg/kg)[b] (Sample #) (depth interval)	Colluvium Concentration (µg/kg)[b] (Sample # - depth) (depth interval)
Acetone	8,000,000			
Acenaphthene				
Anthracene				
Benzene				
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene				
Benzo(f)fluoranthene				
Benzo(k)fluoranthene				
Benzo(g,h,i)perylene				
Benzoic acid				
Butyl benzyl phthalate				
Chlorobenzene				
Chloroform	110,000			
Chrysene				

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Table 9-8 Comparison of Maximum Soil and Sediment Values for Organic Compounds to Environmental Action Criteria - Other Outside Closures

Parameter	Soil and Sediment Environmental Action Criteria (mg/kg)[a]	Sediment Concentration (μg/kg)[b] (Sample #) (depth interval)	Soil	
			Rocky Flats Alluvium Concentration (μg/kg)[b] (Sample #) (depth interval)	Colluvium Concentration (μg/kg)[b] (Sample # - depth) (depth interval)
Dibenz(a,h)anthracene				
Dibenzofuran				
Ethylbenzene				
Fluoranthene				
Fluorene				
Indeno(1,2,3-cd)pyrene				
Methylene chloride	--			
Naphthalene				
Pentachlorophenol				
Phenanthrene				
Phenol				
Pyrene				
Tetrachloroethene	--			
Trichlorofluoromethane				
Toluene				

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Table 9-8 Comparison of Maximum Soil and Sediment Values for Organic Compounds to Environmental Action Criteria - Other Outside Closures

Parameter	Soil and Sediment Environmental Action Criteria (mg/kg)[a]	Sediment Concentration (μg/kg)[b] (Sample #) (depth interval)	Soil	
			Rocky Flats Alluvium Concentration (μg/kg)[b] (Sample #) (depth interval)	Colluvium Concentration (μg/kg)[b] (Sample # - depth) (depth interval)
Total Xylenes				
1,1,1-Trichloroethane	7,000,000			
1,1,1-Trichloroethene				
2-Butanone	--			
2-Methylnaphthalene				
4-Chloro-3-methyl phenol				
di-n-Butyl phthalate	8,000,000			
di-n-Octyl phthalate	--			
bis(2-Ethylhexyl)phthalate	83,000			
N-Nitrosodiphenylamine				

a Risk criteria are the lowest concentrations reported for Health-Based Criteria for Systematic Toxicants and Carcinogens (Tables 8-6 and 8-7 in EPA, 1989c) Criteria reported in Tables 8-6 and 8-7 (EPA, 1989b) are reduced by 100 to provide a safety factor to biota.

b Organics listed are those reported at OU10 by previous investigations. Because the data reported were not validated, numerical comparisons with action criteria are inappropriate at this time. This table will be completed as part of the Phase I RFI/RI.

The occurrence of these metals at elevated levels does not necessarily imply that they are available for assimilation in all organisms or that they transfer to successive trophic levels. The potential for adverse effects to occur is dependent on a number of physicochemical factors including: (1) physiological and ecological characteristics of the organism; (2) forms of dissolved trace metals; (3) forms of trace metals in ingested solids; and (4) chemical and physical characteristics of water (Jenne and Luoma, 1977). Each of these factors will be considered in the evaluation of potential adverse environmental effects at OU10. Brief summaries of information from the Ambient Water Quality Criteria (AWQC) document (EPA, 1986) and other available toxicological literature on these metals of likely concern will be evaluated against site-specific concentrations data in the selection of COCs and key receptor species.

Terrestrial Ecosystems--Heavy metals are the most commonly evaluated environmental contaminants in biomonitoring studies of terrestrial ecosystems. Studies on heavy metals are of several types including: (1) reports of metal concentrations in animals from only one location; (2) correlations of tissue concentrations with environmental concentrations; (3) monitoring a site through time; (4) contaminant concentrations in animals collected along a gradient of pollution; and (5) comparisons of concentrations in animals from reference and contaminated sites or from sites where contamination is suspected. These studies generally provide information on background concentrations of contaminants and correlations of tissue concentrations with environmental concentrations. Data from the Talmage and Walton (1990) study are available for most heavy metals for a variety of mammal species and lower trophic levels.

Several heavy metals are phytotoxic and are known to bioaccumulate and biomagnify in terrestrial and aquatic ecosystems. Bioaccumulation, the process by which chemicals are taken up by organisms directly or through consumption of food containing the chemicals, is documented in aquatic ecosystems for arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and selenium. Biomagnification, or the process by which tissue concentrations of chemicals increase as the chemical passes up through two or more trophic levels, is documented in terrestrial ecosystems from soil to plants for beryllium, cadmium, chromium, copper, lead, mercury, and selenium. In herbivores, biomagnification occurs for antimony, arsenic, cadmium, chromium, copper, lead, mercury, and selenium. In terrestrial carnivores, mercury and cadmium are known to biomagnify. Any, if not all, of these metals are likely to become COCs in the OU10 EE depending on historical usage, concentrations detected in soils, and potential uptake by biological receptors.

Aquatic Ecosystems--EPA has established AWQC to be protective of the environment (EPA, 1986). Specifically, these criteria represent the maximum allowable water concentrations consistent with the protection of aquatic life. One rationale for establishing criteria protective of aquatic life is that aquatic organisms and plants are important in food chains to higher life forms. In addition, their direct dependence on the aquatic environment results in constant contact with water; the organisms are, therefore, likely to assimilate any contaminants. One EPA objective in establishing AWQC was to determine chemical concentrations that would not be directly harmful to aquatic organisms and plants and would not present a hazard to higher life forms due to any biomagnification of individual chemical substances.

Radionuclides

In OU10, several radionuclides have been detected: gross alpha; gross beta; americium 241; plutonium 239, 240; uranium 233, 234; and uranium 238. All of these have been detected in soil. In this medium, americium, plutonium, and uranium were reported at elevated levels. Limited surface water and groundwater samples and a few sediment samples have been analyzed from OU10. Gross alpha and gross beta have also been detected in surface water, but are below background value.

The following discussion is a brief summary of the radionuclide literature reviewed. In general, transuranics tend to bind in the soils and sediments and have limited availability to biota. Bioaccumulation or concentration factors routinely are low between trophic levels. Data from Little et al. (1980) from the RFP site indicate that radionuclide inventories (and thus radiation doses) in vertebrate populations are well below levels known to elicit effects. Based on the following cursory literature review, it seems unlikely that at the low dose levels reported sufficiently sensitive methods exist to distinguish adverse biological response from background "noise" (chance fluctuations due to climate, weather, human disturbance, etc.) at RFP.

Terrestrial Ecosystems--Historically, the principal reason for determining bioaccumulation factors (BAF) for terrestrial biota was to calculate the internal radiation dose to higher trophic levels at an equilibrium body burden from radionuclides assimilated from foodstuffs. For the most part, BAFs for mammals have been collected from fallout studies under widely varied habitat conditions (arctic, desert, temperature zone, and laboratory), and, consequently, there are few consistent generalizations. Accumulation factors for cesium 137 typically show an increase from plants to mammalian herbivores as well as increases at the higher trophic levels. Ninefold increases in cesium 137 through the plant → mule deer → cougar food chain were demonstrated in the work done by Pendleton et al. (1965). Also an increase of approximately 2- to 5-fold at each link in the lichen → caribou → wolf food chain has been reported by Hanson et al. (1967).

Less comprehensive data are available for the other radionuclides, but it is evident that not all radionuclides are accumulated in food chains and that different food chains may exhibit markedly different concentration patterns for the same nuclide. The strontium 90 BAF for the plant → herbivore chain ranges from 0.02 to 8.4, while the BAFs for tritium, cobalt 60 and iodine 131 are less than 1.0, with the exception of 2.4 for seed → water → quail for cobalt 60 movement (Auerbach, 1973).

There have been few field studies on the comparative uptake of actinides (transuranics) by biota from contaminated soils. Uranium, thorium, and plutonium transfer in terrestrial food chains has not been well studied because of the difficulty and expense of analyzing these elements at low levels in biota and the frequent high degree of variation in field data that complicates statistical comparisons between different actinides. Field studies that have been conducted on soil-plant-animal transfer suggest that bioaccumulation of these elements does not occur. The Hakonson (1975) study of actinide levels in soils, plants, and animals indicates that at the Trinity Site residual plutonium was approximately 10 times lower in small rodents than in the corresponding grass samples. This same trend has been noted in other studies as well (Garten and Daklman, 1978; Garten et al., 1981). Bly and Whicker (1978) found that the mean ratio of plutonium 239 in arthropods to plutonium 239 in 0 to 3 centimeters (cm) soil at RFP was $1:9x10^{-3}$.

Little et al. (1980) conducted a comprehensive study in the grassland ecosystem around RFP. The overall conclusions mirror the previously mentioned works in that plutonium was not accumulated up through the food chain. Additionally, the body burdens of biota were significantly lower than required to elicit a biological or ecological effect.

A study by Edwards (1969) revealed distinct differences in radiosensitivities of various microarthropod groups, but all were killed at levels much lower than those lethal to microflora. Orbatid mites, the most radiation-resistant microarthropods, were killed by 200 kilorads.

Auerbach et al. (1957) found that with lower radiation doses a lag effect exists in growth rates in certain microarthropods, such as *Collembola.* Cawse (1969) noted that bacteria are the most tolerant to radiation up to about 2.5 megarads. Fungi are resistant up to about 1 megarad (Johnson and Osborne, 1964).

Fraley and Whicker (1973) found native shortgrass plains vegetation to be very resistant to chronic gamma radiation at exposure rates varying from 0.01 to 650 Roentgen/hour (R/hr, usually expressed as roentgen equivalent man-rem). One of the most resistant species was *Lepidium densiflorum*, which became dominant at exposure rates of 12 to 28 R/hr and was able to germinate, develop, and complete seed set at exposure rates greater than 28 R/hr. The level of radiation exposure in their study is many orders of magnitude greater than any encountered in the environment around facilities such as RFP.

A long-term project was initiated in 1968 at Oak Ridge National Laboratory (Styron et al., 1975) to assess effects of mixed beta and gamma radiation from simulated fallout on a grassland ecosystem. Extensive statistical analyses of data on numbers of individuals collected for each of the 76 arthropod and 2 molluscan taxa have identified no lasting significant changes in similarity or species diversity of experimental versus control communities as the result of the long-term irradiation at low doses rates. Natural fluctuations in community dynamics obscured any possible radiation effects.

Mammalian species and populations exhibit a similar resistance to chronic low-level exposures and even acute exposures required in excess of 100 rads to elicit reproductive, hemopoietic, or survivorships responses (Kitchings, 1978).

Aquatic Ecosystems--Aquatic food chain dynamics are similar to those previously described for terrestrial ones. On the whole, the actinides have no known biological function and do not show an affinity for muscle in higher trophic level organisms (Poston and Klopfer, 1988). In a study conducted at the Savannah River Plant by Whicker et al. (1990), aquatic macrophytes were found to have the highest concentration ratio, primarily, the authors suggest, due to adsorption of sediment particulates to surfaces. All other trophic levels were found to have very low concentration ratios. In nearly all cases, concentrations of transuranics in vertebrate tissues were very low. Because of low food chain transfer factors for most uranics, low concentrations in water, sediments, macrophytes, and invertebrates generally result in low concentrations of transuranics in vertebrate tissues (Bair and Thompson, 1974; Eyman and Trabalka, 1980).

Only 5 to 10 percent of the americium and plutonium in sediments in a process waste pond on the Hanford Reservation were found to be available for food web transfer (Emery et al., 1975). The remaining fraction appeared to be tightly bound to particles and would be transported ecologically in particulate form. Watercress had a plutonium concentration about equal to that found in the sediments, while dragonfly larvae and snails had americium levels approximating levels in the sediments. All remaining biota had plutonium and americium concentrations that were generally well below those of the sediments. Goldfish in a pond concentrated small amounts of both isotopes.

With respect to the distribution of several long-lived radionuclides within aquatic ecosystems, the work of Whicker et al. (1990) tends to confirm and strengthen the concept that many radionuclides tend to reside entirely in the sediments. It appears that this is true for cesium 137 and the transuranium elements. The rule also seems to hold for different types of systems with widely varying limnological properties. As a consequence, only a very small fraction of the total system inventory can reside in the biotic components. For radionuclides that tend to sorb strongly to sediments, this distribution can probably be extended to most freshwater ecosystems.

Organic Compounds

Analysis of soil samples included Hazardous Substance List (HSL) volatile organic acids (VOAs), HSL base neutral acid extractable organics (BNAs), and HSL metals. Therefore, all the organic compounds found at OU10 (Table 9-2) are on the HSL. Each is known to cause adverse acute and chronic effects to biota in sufficiently high concentrations. Sixteen organic chemicals were detected in the OU10 IHSSs. These chemicals are directly reflective of the contaminant sources at OU10 as discussed in Section 2.0.

Chemicals that are readily accumulated by aquatic biota and are persistent in aqueous media (e.g., petroleum distillates) require evaluation of their potential adverse affects on site-specific biota. While there is no history of their disposal, detection of pesticides, PCBs, or dioxins in the Phase I RFI/RI analytical program for abiotic media would also warrant further consideration in this EE. Locations of elevated levels of such organic chemicals in groundwater would warrant evaluation if there is potential interaction with surface water and subsequent potential for exposure to receptor organisms. Given the preponderance of volatile organics in the potential organic contaminants at OU10, given the general lack of concern regarding adverse effects of volatile organics on terrestrial biota because these compounds are so transitory in portions of the environment with direct pathways to biota, and given the poor development of aquatic habitats in OU10 an extensive survey of organic compound impacts on biota was not done in the scoping of this work plan. Literature investigation of organic toxicity will not be done unless warranted by site-specific data from the Phase I abiotic program.

Identification of Potential Contaminants of Concern

The criteria for identification of potential contaminants of concern were developed on a site-wide basis as part of Task 1 for several Ous concurrently. They are presented here with the results of Task 2 data collection for OU10 so that they may be presented with the list of chemicals identified at OU10.

COCs are chemicals that are associated with activities at a hazardous waste site, are suspected to occur in environmental media as a result of activities at the site, and have the potential to damage natural populations or ecosystems. In this context, chemicals include organic compounds, inorganic compounds, elements, and radionuclides. The list of COCs is used to select target analytes for testing biota and/or environmental media for contamination.

Identification of COCs for each EE is based on documentation of the occurrence of the chemical in environmental media, the ecotoxicity of the chemical, and the extent of contamination. These criteria are presented in more detail below.

Occurrence

The known or suspected occurrence of a chemical in environmental media is gleaned from the following criteria, which correspond with those presented in Table 9-9:

a. Existing data from abiotic media (soil, water, air) or from biota, or
b. Waste stream identification and disposal practices, or
c. Process analyses that identify potentially hazardous substances used in large quantities, or
d. Historical accounts of use or accidental releases.

Table 9-9 Preliminary Identification of Contaminants of Concern (COCs) for Biota - OU10

	CRITERIA														COC STATUS
	Criterion 1 (1) Occurrence				Criterion 2 (2) Ecotoxicity			Criterion 3 (3) Extent of Contamination							
Chemical	a.	b.	c.	d.	a.	b.	c.	a.	b.	c.	d.	e.	f.	g.	
	or	or	or		or	or			or			or	or		
				and			and	and		and	and				
Organics:															
Acetone															
Benzene															
Bis(2-ethylhexyl)Phthalate															
2-Butanone															
4-Chloro-3-Methylphenol															
Carbon Tetrachloride															
Chloroform															
Chloromethane															
Ethylbenzene															
Fluoranthene															
Methylene Chloride															
Naphthalene															
Phenanthrene															
Phthalates															
Pyrene															
Tetrachloroethene															
Toluene															
Trans-1,2-Dichloroethene															
Trichloroethene															
1,1,1-Trichloroethane															
Total Xylenes															
Inorganic Ions:															
Nitrate															
Sulfate															
Metals:															
Aluminum															
Antimony															
Arsenic															
Barium															
Beryllium															
Cadmium															
Chromium															
Cobalt															
Copper															
Cyanide															
Iron															
Lead															

	CRITERIA														COC STATUS
	Criterion 1 (1) Occurrence				Criterion 2 (2) Ecotoxicity			Criterion 3 (3) Extent of Contamination							
Chemical	a.	b.	c.	d.	a.	b.	c.	a.	b.	c.	d.	e.	f.	g.	
	or	or	or		or	or			or			or	or		
				and			and	and		and	and				
Lithium															
Magnesium															
Manganese															
Mercury															
Molybdenum															
Nickel															
Potassium															
Selenium															
Silver															
Strontium															
Thallium															
Tin															
Vanadium															
Zinc															
Radionuclides:															
Americium															
Cesium-137															
Gross Alpha															
Gross Beta															
Plutonium															
Radium-226															
Strontium-89															
Strontium-90															
Tritium															
Uranium															

(1)
- a. Existing abiotic data
- b. Waste stream/ disposal
- c. Process analyses
- d. Historical

(2)
- a. Acute or chronic effects for biota
- b. Sublethal effects for biota
- c. Bio-accumulates in biota

(3)
- a. Above background level
- b. Above pertinent biota ARAR
- c. Above 1/100 of EPA action criteria
- d. Occurs in >5% of samples
- e. Widely distributed (in >20% of sampled locations)
- f. Occurs in ecologically sensitive area
- g. Occurs in "hot spots"

The resulting list of chemicals is then evaluated for ecotoxicity and the extent of contamination at the site.

Ecotoxicity

For purposes of evaluating potential COCs, the ecotoxicity of a chemical is determined from its documented adverse effects on biota, or potentiation of toxic effects of other chemicals. A chemical is considered for inclusion in the list of COCs if, at levels detected within the OU, it exhibits:

a. Acute and chronic toxicity, including mortality and teratogenicity, or

b. Sublethal toxicity, including carcinogenicity, reduced growth rates, reduced fecundity, and behavioral effects, or

c. Toxicity resulting from bioaccumulation due to absorption of the chemical directly from environmental media or ingestion of contaminated food items.

The above information may be extracted from federal or state regulatory guidelines, chemical information databases, or scientific literature. The resulting list of chemicals is then evaluated for extent of contamination at the site.

Extent of Contamination

To support identification of a chemical as a COC, the extent of contamination should be such that it results in significant exposure of ecological receptors. A chemical is retained in the list of preliminary COCs if:

a. It is present above natural background concentrations, and either

b. It is present above regulatory standards or ARARs, or

c. It is present above risk-based "acceptable levels", or both.

The chemical is finally identified as a preliminary COC if it also:

d. Is reported in greater than 5 percent of the samples analyzed for the OU, and exhibits at least one of the following characteristics;

e. It is widely distributed, or

f. It occurs in ecologically sensitive areas such as wetlands or seeps that may serve as a drinking water source for wildlife, or

g. It occurs in localized areas of high concentration ("hot spots").

Chemicals that satisfy the above criteria of occurrence, ecotoxicity, and extent of contamination are identified as preliminary COCs for an EE.

Additional Factors

Depending on physical and chemical properties, contaminants may become differentially distributed among environmental media or among components within a medium. The result may be differential bioavailability or exposure of species or populations to the contaminant. The factors affecting distribution in environmental media include the following:

a. Persistence, the resistance to degradation by abiotic or biotic processes

b. Volatility, the tendency to volatilize, thus reducing soil or water concentration

c. Mobility, the degree to which a chemical tends to migrate within or between environmental media, putting further resources at risk

d. Solubility, the tendency to dissolve in aqueous media, which may affect mobility in surface water and groundwater, and tendency to segregate into soil or sediment

e. Differential accumulation, the tendency to segregate into different environmental media or components of a single medium.

These factors and the decision processes illustrated in Figures 9.1-5 and 9.1-6 are considered when developing a target analyte list for laboratory analyses of specific organisms, tissues, or abiotic media.

Table 9-9 shows these criteria for selection of preliminary COCs and lists the chemicals identified as potential COCs at OU10. The list of potential COCs was based on information from previous investigations. From the list of all chemicals considered to potentially occur at the site, only those that are documented to occur in the environment at concentrations above background level should be carried through the remaining criteria. Acquisition of the data needed for completion of the columns in Table 9-9 will be initiated following the validation of data from analysis of abiotic media samples. It is hoped that this effort can be initiated during Tasks 4 and 5 of the EE and will be completed during Tasks 8 and 9. The quantity and quality of data now available for the OU10 preclude meaningful completion of Table 9-9 at this time.

Protected Wildlife, Vegetation, and Habitats

The following discussion of protected wildlife, vegetation, and habitats is a result of continuing consultation with the U.S. Fish and Wildlife Service (USFWS) as part of Section 7 requirements regarding federally threatened and endangered species, with the Colorado Division of Wildlife (CDOW) regarding state species of concern, and with the U.S. Army Corps of Engineers (COE) regarding wetland protection. The species and habitats discussed are potentially present on RFP; a few have been identified to date somewhere on RFP, as noted in the discussion. None have been documented in OU10 IHSSs. Recent surveys follow concepts being developed with the USFWS for identifying and reporting threatened and endangered and special status species at RFP. Of the species identified, only forktip three-awn (*Aristida basiramea*) is likely to occur as other than a transient at any of the OU10 IHSSs based on the habitats and substrates noted during the reconnaissance site visit.

Wildlife

The USFWS has identified several listed endangered or threatened wildlife species that could possibly occur in the RFP area. However, none is expected to occur as other than a transient individual because of lack of habitat. These species include the endangered bald eagle *Haliaeetus leucocephalus*; the two threatened subspecies of peregrine falcon, *Falco peregrinus tundris* and *F. p. anatum*; the endangered whooping crane *Grus americana*; the endangered black-footed ferret *Mustela nigripes*; the endangered least tern *Sterna antillarum*; and the threatened piping plover *Charadrius melodus*. These and other species of particular interest are listed in a recent evaluation of threatened and endangered species potentially present at the RFP site (EG&G, 1991b) or in more recent communications between EG&G and the USFWS (Archuleta, 1991).

The bald eagle is primarily a winter resident around rivers and lakes, and the closest known nesting pair is found at Barr Lake, 25 miles to the east of RFP. Although the RFP site lacks suitable bald eagle nesting habitat, bald eagles have been observed over RFP, and one pair has been observed feeding regularly at Great Western Reservoir, located approximately 0.4 mile east of the site. Field data from 1991 document this species soaring over the plant site and flying over the northeast portion of the buffer zone. None were observed to roost or hunt over the plant site (DOE, 1991a).

The two subspecies of peregrine falcon may occasionally occur in the RFP area as they hunt for prey. There have been several sightings of hunting individuals on the RFP site (DOE, 1991a).

Nesting preferences are high cliff sides and river gorges, both of which are absent at RFP. However, nesting sites have been recorded about 4 to 5 miles west of the site.

The whooping crane passes through Colorado during its spring and fall migrations. Whooping cranes blown off their migration course could use the RFP area as a night roost. These birds prefer large marshes and wetlands in broad open river bottoms and prairies. Such habitat is not present at RFP.

The historical geographic range of the black-footed ferret coincides with that of prairie dogs, a principal prey species. Although black-footed ferret populations are now believed extinct in the wild, large prairie dog towns sufficient to support a black-footed ferret population (more than 80 acres for black-tailed prairie dogs), if found at RFP, would be surveyed by approved methods (USFWS, 1986). None of the prairie dog towns present on RFP are presently this large (DOE, 1991a).

The least tern and piping plover are both shorebirds requiring habitats for breeding different from those present on RFP. Either species is a potential transient through the site, but would find nothing to attract them to the OU10 IHSSs.

Other wildlife species of high federal interest (i.e., listed as Category 2 species or as species proposed for listing) that are potentially present at RFP include the harlequin duck *Hysterix hysterix*, black tern *Chlidonias niger*, white-faced ibis *Plegadis chichi*, ferruginous hawk *Buteo regalis*, western snowy plover *Charadrius alexandrinus nivosus*, mountain plover *Charadrius montanus*, long-billed curlew *Numenius americanus*, Preble's meadow jumping mouse *Zapus hudsonius preblei*, swift fox *Vulpes velox*, and fringed myotis *Myotis thysanoides* (EG&G, 1991b;

Archuleta, 1991). To date, only the Preble's meadow jumping mouse was documented to occur at RFP in spring 1991 (DOE, 1991a); the identification is not documented by a voucher specimen. The ferruginous hawk was observed on RFP in winter, spring, and early summer. One individual was resident primarily in the vicinity of Woman Creek and along the 881 Hillside for a 6-week period in late spring and early summer. Nesting was not documented (DOE, 1991a).

In addition to these bird and mammal species, three other species of high federal interest as C2 species are the Texas horned lizard *Phrynosoma cornutum*, northern leopard frog *Rana pipiens*, and plains top minnow *Fundulus sciadicus*. Of these, the northern leopard frog has been identified on RFP (DOE, 1991b); none of the OU10 IHSSs provide good habitat for this species. The Texas horned lizard was not identified in the Baseline Wildlife/Vegetation Studies Status Report (DOE, 1991b) to be a species expected on RFP.

Vegetation

Four plant species of special concern that are potentially present include one species proposed for listing as a threatened species (Diluvium lady's tresses *Spiranthes diluvialis*), one species of high federal interest (Colorado butterfly plant *Gaura neomexicana* var. *coloradensis*), and two species of concern in Colorado (forktip three-awn *Aristida basiramea* and toothcup *Rotala ramosior*). Of these, the forktip three-awn was reported along Woman Creek in 1973 (EG&G, 1991b) and was reported in 1991 along an old roadway in the western portion of the buffer zone (DOE, 1991a). The toothcup was reported in a temporary pool approximately 6 kilometers (km) east of Boulder, and the Diluvium lady's tresses was reported near Clear Creek to the south of RFP and near South Boulder Creek to the north of RFP (EG&G, 1991b); selected site-specific surveys done for this species in 1991 did not find it. The Colorado butterfly plant has not been reported near RFP, but wetlands along major creeks represent suitable habitat.

Wetlands

Numerous regulations and acts have been promulgated to protect water-related resources, including wetlands. Wetlands play an important role in ecosystem processing and in providing habitat to a variety of plant and animal species. Wetlands at RFP were identified in conjunction with the National Wetlands Inventory (1979) and field checked by U.S. Army Corp of Engineers personnel to verify their jurisdictional status (EG&G, 1990c). Of the site-wide wetlands officially designated as jurisdictional, those that could potentially be associated with OU10 impacts are reaches of the unnamed tributary to Walnut Creek and the East Landfill Pond. These two wetlands consist of emergent, intermittently flooded stream channels and artificial, semipermanent ponds. Wetlands around the East Landfill Pond and along Walnut Creek are dominated by a narrow band of cattails, with occasional cottonwoods, willows, and other shrubs. Very sm all wetland areas occur within OU10; none are eligible for jurisdictional status.

DOE activities with a potential to impact wetlands follow regulations designed for their protection. More detailed location-specific evaluations of the jurisdictional status of potential wetlands in areas of proposed projects are being performed as required (EG&G, 1990a, 1990b).

Conceptual Model Development

As stated in the discussion of the approach to implementation of EEs on RFP, three types of data are necessary to best understand the relationship between contamination in abiotic media and its ecological effects: chemical, ecological, and toxicological. Chemical data on abiotic media will be provided by the Phase I RFI/RI sampling program presented in earlier sections of this work plan. These data will be used to compare with ecological and toxicological study data and to evaluate the need for further ecological study in areas not ecologically studied but found to have contaminated abiotic media in Phase I.

A reconnaissance site visit was made to all 16 of the OU10 IHSSs. Further ecological surveys will be done in association with selected sites. To select the sites at which further investigation was appropriate, three categories were identified relative to the level of ecological field investigation appropriate to them: Category 1--inside a building; Category 2--with no or very scattered weedy vegetation within or adjacent to them in some cases totally surrounded by asphalt and structures; Category 3--adjacent to more extensive habitat, but containing asphalt and structures and little or no weedy vegetation, or with depauperate wildlife habitat within the site. Only Category 3 sites will be associated with further ecological surveys. These surveys will be in each of five habitat areas identified during scoping and used to characterize the Category 3 sites and their zone of potential influence. Figure 9.1-2 shows the locations of the five habitat areas and their relationship to the Category 3 IHSSs. Also during the scoping process it was decided not to select reference areas during this Phase I RFI/RI effort. The highly disparate nature of the disturbance and development at each site would make selection of comparable reference areas more time consuming than is warranted by the ecological condition of these IHSSs. Any subsequent RFI/FI programs will reevaluate this decision if the Phase I results show this is necessary.

Toxicological tests will be done in association with selected Category 2 and 3 sites. A small number of chemical analyses of tissues from target biota taxa will be done, and ecological testing of mixed wastes will be done in association with typically wet areas or drainages. These data will identify whether contaminants found on the site have moved into biotic receptors and whether they are present in surface water on selected sites in combinations that are toxic to biota.

The conceptual model to which these three types of data will be applied was identified in Section 2.2 for all media at each of the individual IHSSs that comprise OU10. Section 2.2 addressed in turn the sources of contamination, types of contamination, release mechanisms that allowed the contamination to be available, contamination migration pathways, and receptors of contamination available via the pathways identified. More specifically for biota, once contamination is available in air, surface water (either directly or via groundwater recharge), sediment or soil, it may be inhaled, ingested, or bioconcentrated directly across body surfaces in the case of water. Further, once contamination is present in the lowest trophic levels, it can move up the food chain by successive prey ingestion, if the specific chemicals bioaccumulate.

In the Category 2 sites at OU10, and within the boundaries of most of the Category 3 sites, the most likely food chains are from weedy vegetation to small mammals or small birds, or from weedy vegetation to insects to small mammals or small birds. In the five habitat areas associated with Category 3 sites, these same food chains are expected, with the possible addition of a predator on the small mammals or small birds. These five habitat areas also have a reasonable possibility of connection with food webs extending throughout RFP. There are few locations of aquatic habitat identified in OU10. They are likely to contribute only insect taxa with aquatic life stages to a food web. Winged adult forms of these insects would enter the terrestrial food chains mentioned above. The Phase I status of the RFI/RI program at OU10 and the resulting paucity of data on the presence of contamination in abiotic media or biotic receptors, the disturbed and developed nature of most of the IHSS and the lack of detailed IHSS specific ecological data and of an identified need to collect such data at most IHSSs, collectively make development of a detailed food web inappropriate at this time. The need for more detailed food web analysis and a more ecosystem oriented approach in a subsequent phase of the OU10 RFI/RI will be evaluated as part of fulfilling the DQOs of determining whether there is a need for further ecological study or analysis of chemical impacts to biota at OU10, and of describing the uncertainty in the need for remediation to protect the environment.

9.1.2.3 Task 3: Ecological Field Investigation

As part of the scoping process required to prepare this work plan, a reconnaissance visit to each of the OU10 IHSSs was made and the Phase I RFI/RI Draft Work Plan for OU10 was reviewed. The reconnaissance site visit provided a basis for the preliminary ecological description of OU10 that follows and the establishment of the sampling locations presented in the OU10 EE FSP (Section 9.3). Ecological field investigations yet to be completed are discussed in Section 9.2 and specified in Section 9.3 for five habitat areas identified during the reconnaissance visit as associated with the Category 3 IHSSs.

Wildlife, Vegetation, and Habitats

Overview of OU10 Wildlife, Vegetation, and Habitats

The 16 sites that comprise the Other Outside Closures of OU10 are discrete, noncontiguous IHSSs, most of which are within the RFP Security Area rather than the Property Protection Area (PPA). As a result, they are within the most highly developed portion of the RFP site. The description below of wildlife, vegetation and habitats in these sites is based on a brief reconnaissance visit to each site on June 17 and 18, 1991.

The 16 sites that comprise OU10 may be combined in three categories on the basis of their level of development and the type of biota habitat they provide. The single Category 1 site

(IHSS 205) is inside a building and has no biota associated with it; this site will not be further evaluated under the EE. In Category 2 are seven sites that are totally surrounded by asphalt and structures with no or very scattered weedy vegetation within or adjacent to them (IHSSs 129, 181, 182, 206, 207, 208) or with small amounts of contiguous weedy vegetation and habitat within or adjacent to them (IHSSs 124, 124.1, 124.2, 124.3). The eight sites in Category 3 are adjacent to more extensive habitat and have asphalt and structures plus little or no weedy vegetation within the site (IHSSs 175, 176, 177, 210, 214) or have depauperate wildlife habitat within the site (IHSSs 170, 174a, 174b, 213). Weedy vegetation in this usage includes introduced species characteristic of disturbed locations such as roadsides, and native species characteristic of dry, rocky uplands.

The weedy species found at most of these sites primarily included: kochia *Kochia scoparia*, yellow sweet clover *Melilotus officinalis*, white sweet clover *Melilotus albus*, knot weed *Polygonum sp.*, daisy fleabane *Erigeron strigosus*, scorpionweed *Phacelia heterophylla*, Russian knapweed *Centaurea repens*, goatsbeard *Tragopogon dubius*, wooly plantain *Plantago sp.*, Canada thistle *Cirsium arvense*, musk thistle *Carduus nutans*, peppergrass *Lepidium sp.*, bindweed *Convolvulus arvensis*, ragweed *Ambrosia sp.*, sunflower *Helianthus sp.*, mullein *Verbascum thapsus*, verbena *Verbena bracteata*, toadflax *Linaria dalmatica*, ragwort *Senecio sp.*, dock *Rumex sp.*, Common St. John's-wort *Hypericum perforatum*, salsify *Tragopogon dubris*, quackgrass *Agropyron repens*, filaree *Erodium cicutarium*, yucca *Yucca glauca*, buffalograss *Buchloe dactyloides*, and prickly lettuce *Lactuca serriola*. These species also often formed an ecotone between the asphalt and better developed habitats.

There are five areas of more extensive habitat within the zone of potential influence of one or more Category 3 IHSSs (Figure 9.1-2). Each of these habitat areas is disturbed in the immediate vicinity of the OU10 IHSSs and can be generally categorized as a disturbance habitat type. Small elements of marshland, woodland, and shrubland may be present as minor habitats (SOP 5.11) within the five habitat areas defined for OU10. Several of the habitat areas may be adjacent to more native grassland habitat types away from the IHSSs.

Area 1 is a drainage adjacent to IHSSs 175, 210, and 214 that on the meadow sideslopes contained smooth brome *Bromus inermis*, Japanese brome *Bromus japonicus*, redtop *Agrostis stolonifera*, crested wheatgrass *Agropyron cristatum*, gumweed *Grindelia squarrosa*, Velvety Guara *Guara parviflora*, and cottonwoods *Populus sargentii*. In the bottom of the drainage were common cattail *Typha latifolia* and narrow-leaved cattail *Typha angustifolia*. These species were also found in wet areas outside the berm surrounding Building 980.

Area 2, a more moist area peripheral to IHSS 176, contained sand bluestem *Andropogon hallii*, sand dropseed *Sporobolus cryptandrus*, redtop, eriogonum *Eriogonum sp.*, red threeawn *Aristida longiseta*, crested wheatgrass, mullein, ragwort, yellow and white sweet clover, ragweed, thistle, and sunflower.

Area 3 is the dry upland in the vicinity of IHSS 213. It contained bluegrass *Poa sp.*, needle-and-thread *Stipa comata*, smooth brome *Bromus inermis*, Junegrass *Koeleria pyramidata*, foxtail *Setaria viridis*, western wheatgrass *Agropyron smithii*, as well as some of the more weedy species such as toadflax, mullein, allysum *Alyssum sp.*, plantago, sunflower, goatsbeard, dandelion *Taraxacum officinale*, daisy fleabane, and geranium *Geranium caespitosum*. A spruce tree *Picea pungens* had been planted near the north end of the site. The more extensive grasslands of OU1 and OU2 fall away to the south of this site into the Woman Creek drainage.

Area 4, surrounding IHSSs 170 and 174, is in the PPA and is a dry weedy upland surrounded by extensive grassland areas. Species noted were rush *Juncus sp.*, foxtail, Russian knapweed *Centaurea repens*, peppergrass, geranium, Canada bluegrass *Poa compressa*, and *Gaillardia sp.*

Area 5, adjacent to IHSS 177, is further west from Area 3 and is adjacent to OU1 and the grasslands leading into the Woman Creek drainage.

Plantings adjacent to several of the buildings included horticultural varieties of juniper *Juniperus virginiana* and spruce trees.

Flying over many of these locations and occasionally perched on structures within them were a number of bird species: barn swallow *Hirundo rustica*, house finch *Carpodacus mexicanus*, vesper sparrow *Pooecetes gramineus*, western meadowlark *Sturnella neglecta*, American robin *Turdus migratorius*, western kingbird *Tyrannus verticalis*, Say's phoebe *Sayornis saya*, house sparrow *Passer domesticus*, common grackle *Quiscalus quiscula*, starling *Sturnus vulgaris*, raven *Corvus corax*. The robin observed was a juvenile bird that may have been from a nest in Area 1. Killdeer *Charadrius vociferus* were present on the ground on rocky sites near water in Areas 1, 2, and 3, and a common nighthawk *Chordeiles minor* was perched on a stack of railroad ties in Area 4. A swarm of bees was resting in a cottonwood in Area 1. Damselflies, dragonflies, and grasshoppers were also observed in some of the areas. A plains gartersnake *Thamnophis sirtalis* was found in Area 2. Desert cottontails *Sylviladus audubonii* were present in Area 4.

Identification of Potential Target Biota Taxa

Criteria for the selection of potential target biota taxa were developed on a site-wide basis during Task 1. There were no IHSS specific data on taxa present and their relative abundance identified during Task 2. Therefore, the consideration of potential target biota taxa was delayed until Task 3 so that the criteria could be considered in association with the results of the Task 3 reconnaissance survey of the biota present at each IHSS.

Contaminants can produce adverse effects at all levels of ecological complexity: individuals, populations, communities, and ecosystems. Contaminants can also threaten critical habitats and endangered species. Consideration of contaminant effects at either the individual level or the ecosystem level does not generally lead to the selection of specific taxa for analysis. Target taxa selection criteria, therefore, reflect primarily the population and community levels of ecological complexity.

Some selection criteria are essential, while others must be considered in context. For example, a threat to a single individual from an endangered species or a critical habitat can be important. A threat to many individuals from an abundant population at a lower trophic level may not be important. A threat to many individuals in a population can produce secondary adverse effects on related species that consequently impact community and ecosystem processes.

There are two purposes for selecting target taxa: to assess contaminant effects on biota; and to measure contaminant concentrations in biota. Target taxa for the RI at RFP are identified as assessment endpoints, measurement endpoints, or both. For taxa selected as measurement endpoints, additional criteria distinguish those sampled by destructive techniques (e.g., those analyzed for contaminant concentrations or histopathological effects) from those sampled solely by nondestructive techniques (e.g., population surveys).

Target taxa selected for nondestructive measurement must be potentially affected by the COC, have a reasonable home range relative to the area of contamination, and meet at least one of the following criteria:

- Be endangered, threatened, or otherwise protected (e.g., be a candidate species for federal listing or state protected species)

- Be economically important (a game or pest species)

- Be important in the structure and function of the ecosystem. These include but are not limited to taxa that:

  - Serve as important food species for higher trophic levels
  - Provide habitat for other species in the ecosystem
  - Function as top predators in the food web.

These criteria (Table 9-10) are considered during analysis of data to determine specific impacts at the population or community level.

Taxa for destructive sampling must potentially be affected by the COC in a manner that can be measured in tissues, have a reasonable home range with respect to the potential contamination, and meet all the following criteria:

- Not be an endangered or threatened species

- Have a population sufficient to support collection without producing a direct adverse effect

- Be known to accumulate the particular COC or to demonstrate its effects in a manner that can be assessed by tissue sampling.

The process of target biota taxon selection involves determining the COCs for a particular area of concern (e.g., an OU) and their characteristics relevant to the biota present in the area. If the

	REQUIRED		ALSO CONSIDERED				
Taxon	Potentially Affected	Reasonable Home Range	Threatened or Endangered	Important to Food Web	Important Habitat	Ecosystem Indicator	Economically Important
TERRESTRIAL TAXA							
Plants (1)							
Insects (2)							
Reptiles (3)							
Birds (4)							
Mammals (5)							
AQUATIC TAXA							
Plants							
(aquatic and terrestrial							
plants listed together)							
Invertebrates (6)							
Fishes (7)							
Amphibians (8)							
Reptiles (9)							

(1) To be included on this list, a plant species must be common or abundant within OU10
(2) Insect taxa have not yet been quantified; however, only the aggregate taxa as listed are likely to be sufficiently abundant for tissue analysis
(3) To be included on this list, a reptile species must be documented within the OU 10 study area
(4) To be included on this list, a bird species must be documented within the OU 10 study area
(5) To be included on this list, a mammal species must be documented within the OU 10 study area
(6) Benthic macroinvertebrate taxa have not yet been quantified; however, only the aggregate taxa as listed are likely to be sufficiently abundant for tissue analysis
(7) To be included on this list, a fish must be common or abundant in areas potentially influenced by OU10
(8) To be included on this list, an amphibian species must be documented within the OU 10 study area
(9) To be included on this list, an aquatic reptile species must be documented within the OU 10 study area

contaminant bioaccumulates, food web analysis is indicated. Food web analysis can focus on key species to be sampled for individual or population effects and can identify intermediate species in the food web that are suitable for destructive analysis. If a contaminant is known to produce only phytotoxic effects, primary effects such as loss of plant cover can be measured directly, and secondary effects such as loss of habitat can be addressed for particular species. Species that have lost their habitat also serve as measurement endpoints for secondary effects. Species losses (or impairments) that affect ecosystem-level processes may produce changes in microbial biomass or mineral nutrient concentrations in soil or water. All of these considerations are encompassed in selecting the taxa as destructive measurement endpoints for analysis based on the criteria (Table 9-11) stated above.

As a result of this scoping process, the way in which the Table 9-10 and 9-11 criteria are applied at OU10 has been modified. Given the depauperate nature of the biota communities present at OU10, the disparate nature of the taxa present, the noncontiguous nature of its component IHSSs, and the Phase I status of the RFI/RI, completion of Tables 9-10 and 9-11 for OU10 as a unit is inappropriate, and completion of these tables for each individual IHSS is unwarranted. The criteria presented in Table 9-10 will be considered as part of the analysis of the completed ecological data set from Task 3; not all of these data have been collected. Sections 9.2 and 9.3 identify the studies yet to be completed. The criteria presented in Table 9-11 will be applied to species identified on the basis of abundance and commonality among IHSSs. More specifically, for each sampling location in the fine habitat areas associated with Category 3 IHSSs and for selected Category 2 IHSSs, the three most common taxa representing each of three trophic levels and present in sufficient quantity to be collected will be identified. This will be done during the season when tissue samples are to be collected. Only the taxa so identified will be listed in Table 9-11 and their compliance with the criteria verified. From the taxa that are fully compliant

Taxon	REQUIRED Reasonable ome Range	Sufficient Biomass to Collect(10)	Not Threatened or Endangered	AND AT LEAST ONE Morphological Anomalies	Chemical May Be In Tissue	Effect May Be In Tissue	PRELIMINARY Target Biota Taxa(11)
	and	and	and	or	or	or	
TERRESTRIAL TAXA							
Plants (1)							
Insects (2)							
Reptiles (3)							
Birds (4)							
Mammals (5)							
AQUATIC TAXA							
Plants							
(aquatic and terrestrial							
plants listed together)							
Invertebrates (6)							
Fishes (7)							
Amphibians (8)							
Reptiles (9)							

(1) To be included on this list, a plant species must be common or abundant at OU10
(2) Insect taxa have not yet been quantified; however, only the aggregate taxa as listed are likely to be sufficiently abundant for tissue analysis
(3) To be included on this list, a reptile species must be documented within the OU 10 study area
(4) To be included on this list, a bird species must be documented within the OU 10 study area
(5) To be included on this list, a mammal species must be documented within the OU 10 study area
(6) Benthic macroinvertebrate taxa have not yet been quantified; however, only the aggregate taxa as listed are likely to be sufficiently abundant for tissue analysis
(7) To be included on this list, a fish must be common or abundant in areas potentially influenced by OU10
(8) To be included on this list, an amphibian species must be documented within the OU 10 study area
(9) To be included on this list, an aquatic reptile species must be documented within the OU 10 study area
(10) The most likely animal species is selected on the basis of abundance or equal likelihood within the OU 10; most likely plant species are selected on the basis of palatability and use as forage
(11) Preliminary target biota taxa are selected on basis of collective fit into an RFP food web and the appropriateness of fall collection for the taxon

with the Table 9-11 criteria, a single taxon will be selected to represent each trophic level. The goal in this selection will be to select taxa that are represented in the majority of the areas to be sampled.

9.2 EE TASKS

Section 9.2 presents the activities in each of the EE tasks that remain to be done. As described in Section 9.1.4, the diverse IHSSs that comprise OU10 will be combined into three categories that provide different levels of habitat quality and to which the task-specific activities remaining will be variously applied. For IHSS categories 2 and 3 methodologies for the ecological and ecotoxicological field investigations (Tasks 3 and 9) are described in the EE FSP presented in Section 9.3.

9.2.1 Task 1: Preliminary Planning

Task 1 was completed during the scoping for this Phase I RFI/RI work plan.

9.2.2 Task 2: Data Collection/Evaluation and Conceptual Model Development

Task 2 was completed during the scoping for this Phase I RFI/RI work plan, with the exception of the following activities:

- Identification of COCs
- Identification of target biota taxa.

It was determined that COCs will be identified on the basis of results from the Phase I abiotic program. Therefore, they cannot be identified until those data are available. If abiotic media data are not available in time, screening level analyses for metals, organics and radionuclides will be done on biota tissues, rather than analyses for specific COCs.

Target biota taxa will be collected in the summer or fall, after the specific COCs have been identified or screening level analyses have been identified as the alternate approach. A procedure for applying the target biota taxa criteria to the biota present at the site was established during Task 2 (Section 9.1.2). It will be applied to species identified on the basis of abundance and commonality among IHSSs just prior to specimen collection.

Reference areas and detailed food web modeling will not be a part of this Phase I RFI/RI EE program. A generalized food web for the aquatic and terrestrial habitats in the Category 3 IHSSs was presented in Section 9.1.2 as part of the conceptual model.

9.2.3 Task 3: Ecological Field Investigation

A portion of Task 3 was completed during scoping by the reconnaissance site visit. On the basis of that visit, aquatic and terrestrial sampling needs were identified.

As described in the conceptual model, different levels of effort will be devoted to the three categories into which the 16 IHSSs have been placed. The single Category 1 site will not be studied further in the EE because it provides no habitat for biota. The seven Category 2 sites have no vegetation, scattered weeds, or small amounts of contiguous vegetation within or adjacent to the site. No ecological field investigations will be done in association with Category 2 sites. The eight Category 3 sites may include depauperate habitat within them, but all are adjacent to more extensive habitat that they may influence. Some species (e.g., songbirds, larger mammals, reptiles, and raptors) may use these areas daily, seasonally or sporadically, or wander through as vagrants. Survey timing and techniques will consider these uses as appropriate to the community complexity. Therefore, Section 9.3 presents a more extensive sampling program for the five habitat areas associated with these eight sites and their zones of potential influence.

Specific activities that remain in Task 3 are:

- More detailed vegetation/habitat mapping of each of the five habitat areas identified during scoping as associated with Category 3 IHSSs (Task 310)
- Habitat and taxon-specific sampling in each of the five terrestrial habitat areas identified during scoping (Task 310)
- Habitat and taxon-specific sampling in each of the four aquatic sampling locations identified during scoping (Task 310)
- Initial toxicological tests using water samples from each of the four aquatic sampling locations (Task 320).

In each of the terrestrial habitat areas, the minor habitat types identified during scoping will be mapped and the boundaries of the major disturbance habitat type refined. Also in each of the five habitat areas, data will be collected on vegetation, terrestrial arthropods, reptiles and amphibians, birds, small mammals, and large mammals. The foundational data collected will be qualitative and based on description of taxa observed on each IHSS. Quantitative data will reflect the relative abundance of different taxa. These data will be used to document the level of ecosystem complexity present at each IHSS. The specific DQOs for each sampling method are provided in the FSP by taxon and method. Where quantitative data are collected, sampling plots will be nested so that the data on various taxa can be combined to describe that location in detail.

Wetlands were identified in Area 1 adjacent to IHSSs 175, 210, and 214 and in permanent moist areas adjacent to the berm around Building 980. Four sampling locations were identified in these

Area 1 wetland habitats. Information on periphyton, benthic macroinvertebrates, and plankton will be sought in each of these locations. Fish populations are not expected, based on the reconnaissance site visit. In addition to data collected under the OU10 EE program, data from OU1, OU2, and OU5 will be used to evaluate potential influences from IHSS 213 across the dry upland of Area 3 and from IHSS 177 across Area 5 that could contribute to wetland impacts along Woman Creek and the South Interceptor Ditch (EG&G, 1990a).

Sampling locations, frequencies, and methods for the additional ecological field investigations associated with Category 3 sites are provided in Section 9.3, the FSP. The approach as outlined is consistent with the Ecology SOPs that are cited in the appropriate section. The collection of specimens to provide samples for chemical analysis under Task 9 will be coordinated with these ecological studies whenever possible to minimize the field effort.

Initial aquatic toxicity tests using *Ceriodaphnia spp.* and fathead minnows will be conducted on media from the four aquatic sampling locations identified during scoping The toxicity tests provide a screening mechanism to aid in the determination of the nature and extent of contamination, particularly since there is the potential for exposure to mixtures of contaminants. Standardized EPA acute and chronic test methods will be followed in accordance with the NPDES toxicity testing procedures currently being used at RFP.

Due to the character of the habitats present in OU10 IHSSs and the Phase I status of the RFI/RI effort, seasonal ecological field surveys (Tasks 311 through 314) will not be conducted, and reference sites will not be identified (Task 340). For similar reasons, food habits data will not be collected (Task 330).

9.2.4 Contamination Assessment (Tasks 4 through 7)

The contamination assessment for OU10 will be based on the results of the three preceding EE tasks including existing environmental criteria, published toxicological literature, information on other existing site-specific EEs, all data collected under Task 2 of the Phase I RFI/RI for OU10, data to be collected by the Phase I RFI/RI investigation of abiotic media, and on ecological data to be collected under Task 3, and ecotoxicological data from Task 9 of the Phase I RFI/RI EE for OU10. The contamination assessment is the integration and interpretation of information from all these sources. Of specific importance in the contamination assessment will be the comparison of OU10 data on soil, sediment, and water exposure points and measured contaminant concentrations at those points with data on biota from the EE. This will enable determination of potential impacts or injury to the biota identified, characterized, and analyzed under the EE. Present and potential future impacts from movement of contaminants through ecological systems or from direct exposure (inhalation, ingestion, or deposition) will be evaluated. Each of the activities identified for the four contamination assessment tasks will be applied to OU10 data. However, given the nature of the OU10 IHSSs and the Phase I status of this program, none of these activities will be performed in depth. Rather, as stated in the DQOs for this EE, the Phase I program will serve to characterize the ecology of OU10, characterize the nature and extent of contamination in biota, evaluate the effects and significance of any contamination identified, and recommend further studies as necessary.

9.2.4.1 Task 4: Toxicity Assessment

The toxicity assessment will include a summary from the literature of the types of adverse effects on biota associated with exposure to chemicals or radionuclides documented at OU10 IHSSs by the Phase I abiotic program. For these contaminants it will identify relationships among magnitude of exposure, adverse effects, and uncertainties regarding contaminant toxicity to biota.

Ecological receptor health effects will be characterized using EPA guidelines for critical toxicity values when available, in addition to selected literature pertaining to site- and receptor-specific parameters. The toxicological profiles developed will be COC-specific and focus on data for taxa comparable to those found on OU10. Adequacy of the existing database will also be evaluated.

The specific activities to be completed in Task 4 are, therefore, to :

- Compile toxicity literature for COCs (Task 410)
- Assess the toxicity of COCs on OU10 biota (Task 420)
- Prepare toxicity profiles from the above information
- Evaluate the adequacy of the literature available.

9.2.4.2 Task 5: Exposure Assessment and Pathway Model

This task will identify the exposure or migration pathways of the contaminants, taking into account environmental fate and transport through both physical and biological means. Each pathway will be described in terms of the chemical(s) and media involved and the potential ecological receptors. The exposure assessment process will summarize from the available Phase I abiotic program data for each COC a source and mechanism of release to the environment, an environmental transport medium (e.g., soil, water, air) for the released chemical, and an estimate of the concentrations of the contaminant available at that point. This information from the abiotic program will be assessed with EE-developed information for each COC on a point of potential biological contact with the contaminated medium, a biological uptake mechanism at the point of exposure, and an estimate of the chemical intake by biological receptors. Exposure pathways will be evaluated for OU10, but will be modeled in only a very general qualitative way with the pathway approach (Reagan and Fordham, 1991; Thomann, 1981). Site-specific data and field observations will be used to reduce uncertainty in the pathway assessment and strengthen interpretation of the overall study. This exposure assessment will be for present conditions. Potential future conditions will be assessed insofar as the extent of Phase I modeling of contaminant fate and transport under the abiotic program allows.

Therefore, activities to be completed under Task 5 are:

- Analysis of exposure releases (Task 510)
- Development of source-receptors pathways, but due to the nature of the site, without quantified modeling of those pathways (Task 520)
- Identification of present and potential future exposed populations (Task 530)
- Estimation of chemical intake (Task 540) in very general terms due to the nature of the site.

A detailed quantitative pathways model (Task 550) will not be developed in the Phase I EE of OU10.

9.2.4.3 Task 6: Contamination Characterization

Contamination characterization will use the results of Task 5 to characterize current and potential future adverse biological effects (e.g., death, diminished reproductive success, reduced population levels, etc.) posed by OU10 contamination. Adverse effects on receptor species and their populations or habitats will be based on EPA AWQC and literature information on tissue concentrations or organism doses associated with specific adverse effects, to the extent such information is readily available for OU10 COCs. This approach is in agreement with EPA guidance (1989a, 1989b). The potential impacts from all exposure routes (inhalation, ingestion, and dermal contact) and all media (air, soil, groundwater, and surface water/sediment) will be considered in this evaluation as appropriate according to EPA guidance (EPA, 1989a).

The contamination characterization will be focused toward identification of contaminant concentrations in abiotic media that will result in no adverse effects on biota. The "no effect" levels for abiotic media are typically identified as the contaminant concentrations known to produce sublethal effects in the most sensitive (usually highest trophic level) organisms. Where these ecological effects criteria are exceeded, adverse effects are likely to occur. Measured and/or predicted future concentrations of hazardous constituents in abiotic media to the extent available, given the Phase I abiotic modeling effort for OU10, will be compared to these ecological effects criteria in the assessment of environmental effects or risk.

In this Phase I OU10 program, development of ecological effects criteria will be very preliminary and based on available data that document potential adverse effects from COCs on target biota taxa. The level of confidence in the criteria defined will be stated qualitatively, but not quantified. The ecological effects criteria will be used in conjunction with ARARs to evaluate present and potential future adverse effects on biota of OU10 contamination as revealed by the Phase I RFI/RI. This approach will be integrated with the baseline risk assessment process and will assist in evaluation of the need for further study of the site and the need for site remediation.

Therefore, the activities to be completed under Task 6 are:

- Development of a preliminary determination of biota contamination (Task 610)
- Qualitative characterization of the potential for exposure and adverse effects to biota (Task 620)
- Evaluation of the relevance of impacts to the "no action" remedial scenario particularly regarding potential future effects (Task 630).

9.2.4.4 Task 7: Uncertainty Analysis

To address uncertainties, the OU10 EE will present each conclusion, along with the identified issues that support and fail to support the conclusion and the uncertainty accompanying the conclusion. Factors that limit or prevent development of definitive conclusions will also be discussed.

Thus, Task 7 will include the following activities:

- Qualitative evaluation of uncertainty (Task 710)
- Summarization of information on assumptions, uncertainties, and qualifications to the contamination characterization (Task 720).

9.2.5 Task 8: Planning

Task 8 will include planning for tissue analysis studies. Species to be sampled for tissue analyses will be designated in coordination with the Task 3 sampling effort, as noted above in Section 9.1.2.3. To the extent possible, all tissue samples from a particular IHSS will be colocated with each other and with other environmental media samples. This will allow for a determination of site-specific bioconcentration or bioaccumulation factors. Prior to collecting specimens, the species, locations, tissues and number of samples will be identified. The number and types of analyses to be run, the detection limits for contaminants, and the acceptable margin of error in analytical results will also be identified prior to sample collection if the seasonal constraints on sample collection and the availability of Phase I abiotic data allow.

Additional ecotoxicological studies (e.g., reproductive success, enzyme analyses, microbial respiration) will not be considered as part of the Phase I OU10 EE. The criteria prescribed to select methodologies for ecotoxicological studies at RFP OUs are the NRDA criteria to identify methods for establishing injury. Any such studies identified as necessary by the Phase I program will be recommended for future phases. Similarly, further aquatic toxicity tests will not be implemented under the Phase I program, but recommended for future phases if they are deemed necessary.

Thus, Task 8 will include:

- Consideration of additional DQOs to be fulfilled in Task 9 (Task 820)
- Development of measurement endpoints for chemical analysis of selected target analytes in selected species and tissues at a few specific OU10 Category 3 IHSSs (Task 830)
- Modification of the FSP to reflect the specified endpoints (Task 810).

9.2.6 Task 9: Ecotoxicological Field Investigations

The collection of specimens to comprise tissue samples for analyses will comprise the Task 9 ecotoxicological field investigation. Whole bodies or specific tissues will be analyzed depending on which portion is consumed by higher trophic level organisms.

Thus, Task 9 will include:

- Implementation of Task 8 decisions regarding collection of specimens for tissue analysis (Task 910).

Task 9 will not include other ecotoxicological studies at this Phase I stage of the RFI/RI.

9.2.7 Task 10: Final Contamination Characterization and EE Report

Task 10 will include the summary of information and results of the preceding nine tasks. For this Phase I RFI/RI it will not include a detailed quantitative pathways modeling effort

(Task 1010) or a characterization of ecosystem effects (Task 1020). The uncertainty evaluation of Task 7, therefore, will not be expanded (Task 1030). The summarization of information (Task 1040) will result in the preparation and production of the EE section of the Phase I RFI/RI Report. Relevant data from the EE, in addition to relevant Phase I RFI/RI data, will be integrated and evaluated in the characterization of potential environmental impacts. Table 9-12 shows a proposed detailed outline of the report.

The sections outlined in Table 9-12 will fulfill the DQOs provided in Section 9.1.2.1. Specifically:

- The site description of the EE report will describe the ecological setting of each of the IHSSs qualitatively or quantitatively, as appropriate to the ecological complexity of the IHSS

- The report section on contaminant sources and releases will summarize data from the abiotic program for consideration in the EE

- The report section on contaminants of concern will provide the results of using the COC selection criteria and the list of OU10 contaminants identified during scoping and documented by the Phase I abiotic sampling program to define contaminants that are of concern to biota

- The toxicity assessment of the EE report will provide the information to evaluate the toxic effects of the COCs on biota taxa similar to those found at OU10

- The exposure point identification, chemical fate and transport, and exposure point concentration discussions in the report will identify specific exposure points, transport media, and exposure point concentrations potentially available to biota

- The exposure pathways section of the EE report will identify mechanisms and pathways for uptake of COCs by biota

- The ecological effects criteria developed in the report will be evaluated for site-specificity and appropriateness in light of data that determine whether there is evidence of

Table 9-12 Proposed Environmental Evaluation Report Outline for OU10

<u>EXECUTIVE SUMMARY</u>

1.0 <u>INTRODUCTION</u>
- 1.1 OBJECTIVES
- 1.2 SITE HISTORY
- 1.3 SCOPE OF EVALUATION

2.0 <u>SITE DESCRIPTION</u>
- 2.1 PHYSICAL ENVIRONMENT
  - 2.1.1 <u>Air Quality/Meteorology</u>
  - 2.1.2 <u>Soils</u>
  - 2.1.3 <u>Surface Water</u>
  - 2.1.4 <u>Groundwater</u>
- 2.2 BIOTIC COMMUNITY
  - 2.2.1 <u>Freshwater Community</u>
  - 2.2.2 <u>Terrestrial Community</u>
  - 2.2.3 <u>Protected/Important Species and Habitats</u>

3.0 <u>CONTAMINANT SOURCES AND RELEASES</u>
- 3.1 SOURCES
- 3.2 RELEASES

4.0 <u>CONTAMINANTS OF CONCERN</u>
- 4.1 CRITERIA DEVELOPMENT FOR SELECTION OF CONTAMINANTS OF CONCERN
- 4.2 DEFINITION OF CONTAMINANTS

5.0 <u>TOXICITY ASSESSMENT</u>
- 5.1 TOXICITY ASSESSMENTS OF CONTAMINANTS OF CONCERN
- 5.2 CONTAMINANT EFFECTS
  - 5.2.1 <u>Terrestrial Ecosystems</u>
  - 5.2.2 <u>Aquatic Ecosystems</u>

6.0 <u>EXPOSURE ASSESSMENT</u>
- 6.1 CONTAMINANT PATHWAYS AND ACCEPTABLE CRITERIA DEVELOPMENT
  - 6.1.1 <u>General Methodology for Pathway Analysis</u>
  - 6.1.2 <u>Selection of Key Receptor Species</u>

- 6.2 EXPOSURE POINT IDENTIFICATION
  - 6.2.1 Soil
  - 6.2.2 Water
  - 6.2.3 Vegetation
- 6.3 CHEMICAL FATE AND TRANSPORT
- 6.4 EXPOSURE POINT CONCENTRATIONS
  - 6.4.1 Soil and Sediment Concentrations
  - 6.4.2 Surface Water Concentrations
  - 6.4.3 Groundwater Concentrations
  - 6.4.4 Vegetation Concentrations
- 6.5 EXPOSURE PATHWAYS
  - 6.5.1 Terrestrial Pathway
  - 6.5.2 Freshwater Pathway

7.0 CONTAMINATION CHARACTERIZATION
- 7.1 DEVELOPMENT OF ECOLOGICAL EFFECTS CRITERIA
  - 7.1.1 Air Criteria
  - 7.1.2 Soil and Sediment Criteria
  - 7.1.3 Freshwater Criteria
  - 7.1.4 Vegetation Criteria
- 7.2 EFFECTS CHARACTERIZATION
  - 7.2.1 Terrestrial Pathway
    - 7.2.1.1 Air
    - 7.2.1.2 Soil
    - 7.2.1.3 Vegetation
  - 7.2.2 Freshwater Pathway
    - 7.2.2.1 Air
    - 7.2.2.2 Surface Runoff
    - 7.2.2.3 Seeps and Springs

8.0 ASSUMPTIONS AND UNCERTAINTIES

9.0 RECOMMENDATIONS AND CONCLUSIONS

10.0 REFERENCES

contaminants in selected biota tissues collected within specific IHSSs or their zone of influence

- The ecological effects criteria will also be developed on the basis of data that characterize the adverse effects of COCs on biota and identify contaminant concentrations in abiotic media that would result in no such effects

- The effects characterization of the report will evaluate the likelihood of impacts to present or potential future individuals, populations, communities or ecosystems from contaminants identified in any abiotic media at OU10

- The assumptions and uncertainties section will summarize the assumptions, uncertainties, and qualifications appropriate to the overall process of exposure assessment and contamination characterization at this Phase I stage of the RFI/RI

- The recommendations and conclusions section will present information to determine whether there is a need for further ecological study or analysis of chemical impacts to biota at OU10

- The recommendations and conclusions section will also evaluate the need for remediation to protect the environment and describe the source and extent of any uncertainty in that evaluation.

9.3 FIELD SAMPLING PLAN

Field sampling activities will be conducted under Task 3 and Task 9 of the OU10 EE. The Task 3 field surveys and inventory will be conducted to obtain information on the occurrence, distribution, general and abundance of biota in the Category 3 IHSSs of OU10. The Task 9 tissue samples will be analyzed from selected Category 2 and 3 IHSSs to determine whether taxa representing one or more trophic levels are contaminated. The objectives, locations, frequency, use of reference areas, survey and inventory methods, ecotoxicological methods, and equipment are discussed below in turn.

This FSP was developed in conformance with SOP 5.13. DQOs are provided for each field survey and inventory sampling method. Generally, these DQOs are qualitative, although DQO for vegetation sampling are quantitative. Overall, the approach in this FSP is to provide data that will characterize the ecology and biota contaminant levels at OU10, thereby supporting the exposure assessment and overall contamination characterization. Descriptive statistics will be used to summarize the data collected. QA/QC will be provided through the collection of replicates.

9.3.1 Sampling Objectives

The objectives of the Task 3 ecological field investigation for Category 3 OU10 IHSSs are to perform:

- More detailed vegetation/habitat mapping of each of the five habitat areas identified during scoping as associated with Category 3 IHSSs
- Habitat and taxon-specific sampling in each of the five terrestrial habitat areas identified during scoping
- Habitat and taxon-specific sampling in each of the four aquatic sampling locations identified during scoping
- Initial toxicological tests using water samples from each of the four aquatic sampling locations.

During these specific activities, particular care will be taken to note obvious signs or zones of contamination or injury to biota and their habitats, the presence or absence of protected or other important species and habitats, and to note taxa appropriate for Task 9 tissue sampling.

The preliminary site visit to the Category 1 site (IHSS 205) has fulfilled each of these objectives to sufficiency; this site will not be visited again. Similarly, for the seven Category 2 sites, sufficient data for these objectives have been collected on the preliminary site visit, given the depauperate nature of these communities. Additional data will be collected to meet the four objectives above for the eight Category 3 sites.

The objective of Task 9 field sampling is to collect specimens to provide tissue samples for chemical analysis. Both Category 2 and Category 3 sites will be revisited during Task 9 to collect biota tissues for field/laboratory contamination studies.

All of the field sampling activities will be accomplished in compliance with the Ecology SOPs developed for sampling biota as part of the EE process at RFP. These SOPs include discussion of purpose and scope, responsibilities and qualifications, references, equipment, and execution of protocols. Sampling procedures for the following organisms are included in SOPs 5.1 through 5.11 (EG&G, 1991c), respectively: periphyton, benthic macroinvertebrates, plankton, fishes, large mammals, small mammals, birds, reptiles and amphibians, terrestrial arthropods, and terrestrial vegetation. In addition to SOPs on specific taxonomic groups, procedural SOPs (5.11 through 5.15, respectively), have been prepared for Identification of Habitat Types, Sampling of Soil for Soil Description, Development of Ecology Field Sampling Plans, Assignment of Species Codes, and Assignment of Wildlife Habitat Codes. Additional procedural SOPs are still being developed. The preceding SOPS (EG&G, 1991c) are referenced below where appropriate.

9.3.2 Sample Location and Frequency

Figure 9.3-1 shows the locations of terrestrial sampling locations in each of the five habitat areas identified for Category 3 IHSS sampling. It also shows the locations of the four aquatic sampling locations. Sampling locations were largely located at or downgradient from areas of known or suspected contamination. They were selected to be representative of the primary disturbance habitat type in each habitat area. The intent of the selected locations was not to test specific hypotheses regarding the effects of contamination, but to characterize the ecological communities that are present and provide site-specific input to contaminant pathway identification. Just prior to terrestrial and aquatic sampling, the continued appropriateness of each selected location will be verified by a brief site visit. Minor adjustments in locations will be made if necessary. The specific methods to be used at each terrestrial and aquatic sampling location are identified in Sections 9.3.4, 9.3.5, and 9.3.6.

Both Task 3 and Task 9 field sampling activities for OU10 will be located and timed to coincide to the extent possible and appropriate with collection of other media samples (surface water, sediment, and soil) as well as sampling activities at other OUs. This integrated sampling approach is consistent with EPA guidance and will provide a synoptic view of potential contaminants in all relevant media at one time.

9.3.2.1 Locations for Vegetative Sampling

Vegetation sampling for phytosociological data (SOP 5.10) will be performed in each of the locations identified on Figure 9.3-1. When additional detail is added to the vegetation map, minor habitat types (SOP 5.11) will be areally defined, but they will not be quantitatively sampled.

9.3.2.2 Locations for Wildlife Sampling

A terrestrial wildlife inventory (SOP 5.5) will be conducted within the five habitat areas identified for Category 3 OU10 IHSSs and within the boundaries of these IHSSs. Small mammal sampling (SOP 5.6) will be conducted at the terrestrial sampling locations identified in Figure 9.3-1. Thus, small mammal data and vegetation data will be from the same locations.

Bird (SOP 5.7), reptile, and amphibian (SOP 5.8) species observed in each of these terrestrial sampling locations, throughout the five habitat areas, and within Category 3 IHSS boundaries will be recorded.

9.3.2.3 Locations for Periphyton and Benthic Macroinvertebrate Sampling

Figure 9.3-1 shows the four aquatic locations for the collection of periphyton (SOP 5.1) and benthic macroinvertebrates (SOP 5.2) samples for taxonomic identification. Surface water and sediment samples will also be collected at these locations by the OU10 Phase I abiotic program (Section 7.0). Data obtained will be compared with similar information from other OUs, such as OU1, OU2, OU5, and OU6, as available and appropriate. Comparative data from other OUs will be selected from locations that might be impacted by or support interpretation of data from OU10.

9.3.2.4 Locations for Initial Toxicity Testing

Locations for initial aquatic toxicity testing will be the same as those for periphyton and benthic macroinvertebrate sampling (Figure 9.3-1). Data from toxicity testing activities at OU10 will be compared with the results of similar tests at OU1, OU2, and OU5; if available, results from OU6 will also be used for comparison with OU10 data. As for periphyton and invertebrates, comparative data from other OUs will be selected from locations that might be impacted by or support interpretation of data from OU10.

9.3.2.5 Tissue Sampling Locations

Locations for the collection of tissue samples will be the same as those for terrestrial and aquatic ecological sampling. The species for tissue sampling will be identified toward the end of the Task 3 field program on the basis of their abundance and commonality to most sampling locations. The species identified will be run through the criteria for selecting destructive measurement endpoints before they are identified as target biota taxa and collected.

9.3.2.6 Sample Frequency

The locations identified above will be sampled during the May-June (summer) and July-September (fall) time frames. When appropriate, and where sampling and analysis protocol have been established, samples will be saved from the later inventory and used for tissue analysis. The frequency of specific ecological sampling methods is provided in Section 9.3.4.

Task 3 toxicity tests will also be conducted during low flow in September-October. At each of the four sampling sites shown in Figure 9.3-1, two acute and two chronic tests will be conducted within 1 to 2 weeks of each other. If toxicity is observed in either acute or chronic tests at any one station, then further sampling will be recommended for subsequent phases of the RFI/RI.

9.3.3 Reference Areas

Specific reference sites for habitat and taxon-specific ecological sampling will not be selected for the OU10 EE. This is because of the highly disturbed and developed nature of the component IHSSs and the resulting many reasons for ecological variation among sites.

Tissue samples have been collected from reference areas for OU1 and OU2. Since there is overlap of the COCs at those sites with the list of potential COCs for OU10 and since this is a Phase I study more concerned with characterization than with quantification of contamination, additional reference areas for tissue samples will not be selected for the OU10 EE.

9.3.4 Field Survey and Inventory Sampling Methods

Specific sampling methods will be used to characterize the relative abundance of various taxonomic groups in the five habitat areas. These methods will be responsive to selected methods described in the taxon-specific SOPs. SOP forms appropriate to the method will be used. For each taxon, the methods to be used and their measurement endpoints, specific DQOs and sample design are presented below.

9.3.4.1 Terrestrial Plants

For the five habitat areas associated with Category 3 OU10 IHSSs, sampling of terrestrial plants will provide data on areal extent and mapping, species presence/absence, species richness, herbaceous cover, and tree and shrub density and canopy cover. Herbaceous and low shrub production data will not be collected. Areal extent and mapping data will cover the full extent of each of the five habitat areas identified in Figure 9.3-1. It will focus on identification of minor habitat types within the general disturbance habitat type. The remaining types of data will be collected at each of the 13 terrestrial sampling locations (Figure 9.3-1) during fall, except that species will be added to the species list during all visits to every area.

Measurement Endpoints--Measurement endpoints for each habitat area in the ecological sampling of plants are areal extent shown on a map and quantified; species presence/absence; species richness; herbaceous cover, overall and by species; tree and shrub density and canopy cover.

Specific DQOs--Specific DQOs are appropriate for some of these measurements. Areal extent will be calculated as the mean of three measurements of area using computerized planimetering of mapped polygons. Species presence/absence, species richness, herbaceous cover, tree and shrub density and canopy cover will be collected in all established cover transects. Quality assurance/quality control (QA/QC) are provided through the sampling of replicates within the OU. No data specifically for QA purposes were collected. Habitat identification for mapping will be in accordance with SOP 5.11, and other sampling will follow the methods in SOP 5.10.

Sample Design--Sample design is as follows for each of the measurement endpoints. For each endpoint, what was done and how, where it was done, and when it was done are considered in turn. There is no constraint on the time of day for measuring measurement endpoints for plants. Vegetation data will be collected at each terrestrial sampling location during summer (areal extent and mapping, species presence/absence, species richness) and fall (species presence/absence, species richness, herbaceous cover, tree and shrub density and canopy cover).

Areal Extent and Mapping--Vegetation will be mapped in accordance with SOP 5.11. Information from the reconnaissance site visit was used to develop Figure 9.3-1. Aerial photos and a summer site visit will be used to add detail to and finalize the map for each of the five habitat areas.

Species Presence/Absence--Species presence/absence will be determined by analysis of the species inventory list prepared from identification of all species occurring within each of the established plant cover transects or observed elsewhere within the OU10 area. Considerations of presence/absence will be on a habitat-specific basis for each of the five habitat areas. Comparisons will be made to data from other OUs and from the PPA. This is a qualitative method to be done in compliance with SOP 5.10.

Species Richness--Species richness is the number of species occurring within the plant cover transects. For each habitat area a mean and range of richness values will be calculated during analysis of the field data. This is also a qualitative method to be done in compliance with SOP 5.10.

Herbaceous Cover--Herbaceous cover will be recorded by species. This information can also be used to calculate overall plant cover, as well as to document the percentage of bare ground, rock, and litter. At each sampling location within a habitat area, 50 m by 2 m transects will be established. Cover will be recorded at 100 points systematically distributed along the 50 m length of the transect in accordance with SOP 5.10. The species of plant that the point intersects or the presence of bare ground, rock, lichen, or moss is recorded at each point intercept location on the ground.

Tree and Shrub Density and Canopy Cover--As part of the herbaceous cover measurement, the number of individual trees and shrubs more than half contained within the cover plot will be counted as detailed in SOP 5.10. Counts of subshrubs, cacti, and yucca will also be included. In addition, the canopy of trees and shrubs that covers the center line of the plot will be measured by species. The cover contributed by different individuals will not be recorded separately when there is no break between them.

9.3.4.2 Terrestrial Wildlife and Arthropods

For the five habitat areas associated with Category 3 OU10 IHSSs, sampling of terrestrial wildlife and arthropods will provide data on taxon presence/absence, taxon richness, taxon relative abundance for arthropods, amphibians, reptiles, birds, small mammals, and large mammals. For small mammals, data on species relative density per hectare will also be collected. Relative abundance surveys will be done in each of the five habitat areas in summer and in fall. Data will be recorded for the entire habitat area and for each of the terrestrial sampling locations. These transects will provide data on arthropods, amphibians, reptiles, birds, and large mammals. Data on small mammals will be primarily from trapping that will be done at each of the terrestrial sampling locations in fall. Any extensive small mammal burrowing activity will be noted on relative abundance transects.

Measurement Endpoints--Measurement endpoints for each habitat area in the ecological sampling of arthropods, amphibians, reptiles, birds, small mammals, and large mammals are taxon presence/absence; taxon richness; taxon relative abundance. Abundance will be recorded as relative because no statistical adequacy tests will be applied, and it is expected that the variance sampling locations will be quite large. Relative numbers are appropriate for comparison among sampling locations and habitat areas; absolute population numbers are not necessary, particularly during a Phase I study. Arthropods (primarily insects) are being identified to the lowest reasonable taxon, which will vary by taxon, as some arthropods are readily identified to species while others are not. All vertebrate taxa will be identified to species.

Specific DQOs--There are no quantitative DQOs for the measurement endpoints just identified. A qualitative DQO of providing representative sampling of each of the habitat areas is appropriate. Data on each of the measurement endpoints will be obtained during relative abundance surveys in each of the five habitat areas. Data on the density of small mammals per hectare will be recorded in plots established at each of the terrestrial sampling locations and sampled for four consecutive trap nights. QA/QC will be provided through the sampling of replicates within the OU; no data specifically for QA purposes will be collected.

Sample Design--Sample design is as follows for each of the measurement endpoints. For each endpoint, what was done and how, where it was done, and when it was done are considered in turn. Seasonal and diurnal constraints are mentioned for each method. Sampling of each taxon will be accordance with its respective SOP (arthropods, SOP 5.9; reptiles and amphibians, SOP 5.8; birds, SOP 5.7; small mammals, SOP 5.6; large mammals, SOP 5.5).

A single 40-minute relative abundance transect will be run twice in summer and twice more in fall in each of the five habitat areas. One of the transects run in each area during a given season will be before 10:00 a.m. MST and the other will be after 10:00. This will maximize the data collected on birds, which are more active early in the morning, and on arthropods, which are more active in the heat of the day. In addition to the 40-minute length typical of the relative abundance transects run on RFP for other programs, a 15-minute observation period should be devoted to each of the sampling locations within the habitat area. The data from the 40-minute area wide transect and from each 15-minute survey should be recorded separately. This will provide data for each sampling location for direct integration with the site-specific vegetation and small mammal data form that location. During relative abundance transects in these two seasons, data will be collected on particularly obvious insects, such as butterflies, that can be observed while walking the transects. As each transect is run, the length of time spent in each of the habitats crossed recorded, as well as the total time spent. Data from relative abundance transects result in observations per unit time rather than per unit area. All taxa observed will be recorded during the collection of data along a relative abundance transect. Taxon presence will be based on visual observation, vocalization, burrow/den, nest, droppings/scat.

Sampling of small mammals will be in accordance with SOP 5.6. The small mammal plots are expected to vary in their configuration to best fit the sampling location, but regardless of configuration, each mammal plot will consist of 25 trap locations separated by 5 m intervals. Data from the four trap-nights at each plot will be averaged to represent that transect. The seasonal and diurnal constraints mentioned in SOP 5.6 will be followed. Judgment will be used within the limit of these constraints. For example, if the weather is particularly hot or particularly cold, traps will be set later and checked earlier to minimize mortality of trapped small mammals.

9.3.4.3 Aquatic Invertebrates

For the four aquatic sampling locations associated with Category 3 OU10 IHSSs, sampling of aquatic invertebrates will provide data on taxon presence/absence, taxon richness, taxon relative abundance and other measurement endpoints identified below for plankton, periphyton and benthic macroinvertebrates. If warranted by the location, minnow traps will also be used to determine whether invertebrates such as crayfish are present. While no sampling for aquatic vertebrates will be done because none are expected to be present at the sampling locations, the minnow traps should verify the status of fish.

Measurement Endpoints--Measurement endpoints for each habitat area in the ecological sampling of plankton, periphyton and benthic macroinvertebrates are taxon presence/absence; taxon richness; taxon relative abundance; taxon relative density per milliliter of water (plankton) or square millimeter (periphyton); biomass expressed as ash-free dry weight and biovolume (plankton only); chlorophyll a and phaeophytin a (periphyton only); taxon relative density per square meter (benthic macroinvertebrates only); and relative wet-weight biomass per square meter (benthic macroinvertebrates only). As for terrestrial taxa, density will be recorded as relative because no statistical adequacy tests will be applied, and it is expected that the variance among samples will be quite large. Relative numbers are appropriate for comparison among sampling locations and habitat areas; absolute population numbers are not necessary, particularly during a Phase I study.

Plankton, periphyton, and benthic macroinvertebrates will be identified to the lowest reasonable taxon. This will vary by taxon, as some of these organisms are readily identified to species while others are not. Data collected on aquatic macrophytes will be observational only.

Specific DQOs--There are no quantitative DQOs for the aquatic invertebrate measurement endpoints. A qualitative DQO of providing representative sampling of each of the habitats is appropriate. QA/QC will be provided through the sampling of replicates within each OU; no data specifically for QA purposes will be collected.

Sample Design--Sample design is as follows for each of the measurement endpoints. For each endpoint, what was done and how, where it was done, and when it was done are considered. Sampling at each of the four aquatic sampling locations will be done in fall.

Plankton--Sampling of plankton will be in accordance with SOP 5.3. Plankton will be collected at each of the four aquatic sampling locations. Three 50 milliliter samples per location will be collected. Physico-chemical parameters collected in association with each plankton sample are as listed in SOP 5.3. In addition, the depth of the sampling location and general water quality indicators (alkalinity; free and total acidity; total hardness; total suspended solids; apparent color), nutrients (nitrogen as nitrate, nitrite, and ammonia; reactive phosphorus, and sulfate), and other attributes (total chlorine) will be measured with a Hach Kit.

Periphyton--Sampling of periphyton will be in accordance with SOP 5.1. Periphyton will be collected on artificial substrates: tiles and floating slide racks. Tiles will be used at all sites. Floating racks will be used where water is deep enough (more than 30 cm is specified in the

SOP 5.1). All four aquatic sampling locations will be sampled for periphyton. Additional water quality parameters will be measured at the sampling site as for plankton.

Benthic Macroinvertebrates--Sampling of benthic macroinvertebrates will be in accordance with SOP 5.2. At each of the four aquatic sampling locations, a core sampler will be used. At each location, a composite sample volume of at least 2,000 cubic centimeters will be assembled from a minimum of four subsamples. Where a sampling location will accommodate it, a Hestor-Dendee Cube will also be used. Samples collected by these methods will be analyzed to provide data for each of the measurement endpoints. Water quality parameter data will be collected as specified in SOP 5.2, with additional parameters as identified for plankton. All parameters will be measured at the sample collection site.

9.3.5 Initial Toxicity Tests

The initial toxicity testing program will be limited to aquatic organisms and will include standardized EPA acute and chronic tests with fathead minnows and *Ceriodaphnia spp*. Water samples will be cooled to 4°C and shipped to the laboratory conducting the toxicity tests within 12 to 24 hours. The toxicity tests will be initiated within 36 hours of the field collection time. The duration of the static renewal acute tests will be 48 hours for *Ceriodaphnia spp*. and 96 hours for fathead minnows. The test water will be renewed daily using dilution water from the sampling station. The static renewal chronic tests will last for 7 days for fathead minnows and until 60 percent of the *Ceriodaphnia spp*. in the control vessels have three broods. QC procedures will conform to the EPA requirements for NPDES toxicity testing currently being used at RFP and to the QAPjP.

9.3.6 Tissue Analysis Sampling Methods

The methodologies selected for tissue analysis studies will depend on the COCs and their anticipated effects on the selected target biota taxa. COCs will be determined as early as possible following receipt of Phase I analytical data from the abiotic sampling program. DQOs for the collection of tissue samples are to collect a minimum of three replicates of each taxon within OU10 and within each habitat area, to collect at least two trophic levels at each location sampled, to collect the same or similar taxa at all sampled locations, and to collect a minimum of 25 grams of tissue for each sample.

As described at the end of Section 9.1.2.3, the target biota taxa to be sampled for tissue analysis will be identified toward the end of Task 3 ecological sampling. For each sampling location in the five habitat areas associated with Category 3 IHSSs and for Category 2 IHSSs selected on the basis of Phase I abiotic media data, the three most common taxa representing each of three trophic levels and present in sufficient quantity to be collected will be identified. Only the taxa so identified will be listed in Table 9-10 and their compliance with the criteria verified. From the taxa that are fully compliant with the Table 9-10 criteria, a single taxon will be selected to represent each trophic level. The goal in this selection will be to select taxa that are represented in the majority of the areas to be sampled so that the same taxa can be sampled from each location when possible.

It is anticipated that some small mammals trapped in the Task 3 field inventory can be used for tissue analysis. Standardized site protocol for preserving samples for tissue analyses will be followed in those instances where it is anticipated that tissue analyses will be conducted. Tissue samples collected for contaminant analysis will be sent to a laboratory for specific analyses for the COCs selected. Typical holding times, preservation methods, sample containers, and field and laboratory QC sample numbers are contained in the QAPjP and shown in Table 9-13. Sample preparation for biota tissue is not necessarily standardized and may vary depending upon the laboratory conducting the analyses.

Analyses for COCs in biota may call for a greater biomass of tissue than is available through standard collection methods. For example, as shown in Table 9-13, 80 grams of material (wet weight) may be needed per sample for metal analyses, and 100 grams of material (dried and ashed) may be needed for radionuclides. Obtaining this amount of sample may be impractical for some taxa. It is not the intent of the sampling program to cause inappropriate disturbance or damage to the biotic communities in order to collect sufficient samples.

9.3.7 Data Analysis

Data from the field survey, inventory, and aquatic toxicity tests will be summarized, tabulated, and accompanied by a narrative description addressing the measurement endpoints and DQOs identified above. The summary, tabulation, and narrative description based on data in each of these categories will vary in its level of detail for the three categories of sites, with the most detail being provided for Category 3 sites. For these eight sites, descriptive statistics will be prepared and the precision and accuracy of the results will be described qualitatively. Sample sizes will not be adequate for meaningful statistical quantification of precision and accuracy of the results at a stated level of confidence.

The data under this FSP will be supportive of the final contamination characterization and EE report by providing information:

- For the site description

Table 9-13 Holding Times, Preservation Methods, and Sample Containers for Biota Samples

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size++
SAMPLES FOR METALS ANALYSES				
Terrestrial Vegetation				
- Metals Determined by ICP**	6 mos	Freeze & ship w/ dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Metals Determined by GFAA+	6 mos	Freeze & ship w/ dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/ dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Mercury	28 days	Freeze & ship w/ dry ice	Paper bag inserted into plastic bag and sealed	5 g
Periphyton, Benthic Macroinvertebrates, Fish				
- Metals Determined by ICP	6 mos.	Freeze & ship w/ dry ice	Plastic	25 g
- Metals Determined by GFAA	6 mos	Freeze & ship w/ dry ice	Plastic	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/ dry ice	Plastic	25 g

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Table 9-13 Holding Times, Preservation Methods, and Sample Containers for Biota Samples

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size++
- Mercury	28 days	Freeze & ship w/ dry ice	Plastic	5 g
SAMPLES FOR RADIONUCLIDE ANALYSES				
Terrestrial Vegetation				
- Uranium-233, 234, 235, 238 Americium-241 Plutonium-239/240	6 mos	Freeze & ship w/ dry ice	Paper bag inserted into plastic bag and sealed	100 g
Periphyton, Benthic Macroinvertebrates, Fish				
- Uranium-233, 234, 245, 238 Americium-241 Plutonium-239/240	6 mos	Freeze & ship w/ dry ice	Plastic	100 g

**ICP = Inductively Coupled Argon Plasma Emission Spectroscopy. Metals to be determined include Ba, Cr, Cu, and Fe.

+GFAA = Graphite Furnace Atomic Absorption Spectroscopy. Metals to be determined include As, Cd, Li, Pg, Se, and Sr.

++ = Sample size may vary with specific laboratory requirements.

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- To identify the types of biota toward which toxicity assessments should be focused
- To identity receptor biota to and through which pathways from exposure points should be defined
- To compare site-specific tissue contaminant levels with established acceptable levels
- For evaluating the likelihood of impacts to present biota and predicting impacts to future biota at various IHSSs.

9.3.8 Sampling Equipment

Equipment for field sampling of biota is identified in the Ecology SOPs (Volume V, EG&G, 1991c) for the sampling of each taxonomic group.

9.4 SCHEDULE

Figure 9.4-1 presents a proposed schedule for implementation of the OU10 EE. The schedule follows the task approach presented in this EE. While many of the tasks are sequential, most tasks will overlap in time. The months indicated in the table reflect the time frame in which the activity will occur and not necessarily the amount of time necessary to complete the task. The schedule is provisional and likely to change depending on the OU10 Phase I RFI/RI activity schedule as well as schedules from other OUs. It must be noted that Tasks 3 and 9 on the schedule have seasonal constraints that must be met if ecological data and samples are to be properly collected. Phenology at project startup must allow habitat mapping to be the first task.

Approved by:

____________________ / / ____________________ / /

Manager, Remediation Programs RFI Project Manager

QUALITY ASSURANCE ADDENDUM

This section consists of the Quality Assurance Addendum (QAA) for Phase I investigations at Operable Unit No. 10 (OU10), which supplements the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP). This QAA establishes the site-specific Quality Assurance (QA) controls applicable to the investigation activities described in the OU10 Work Plan (OU10 WP).

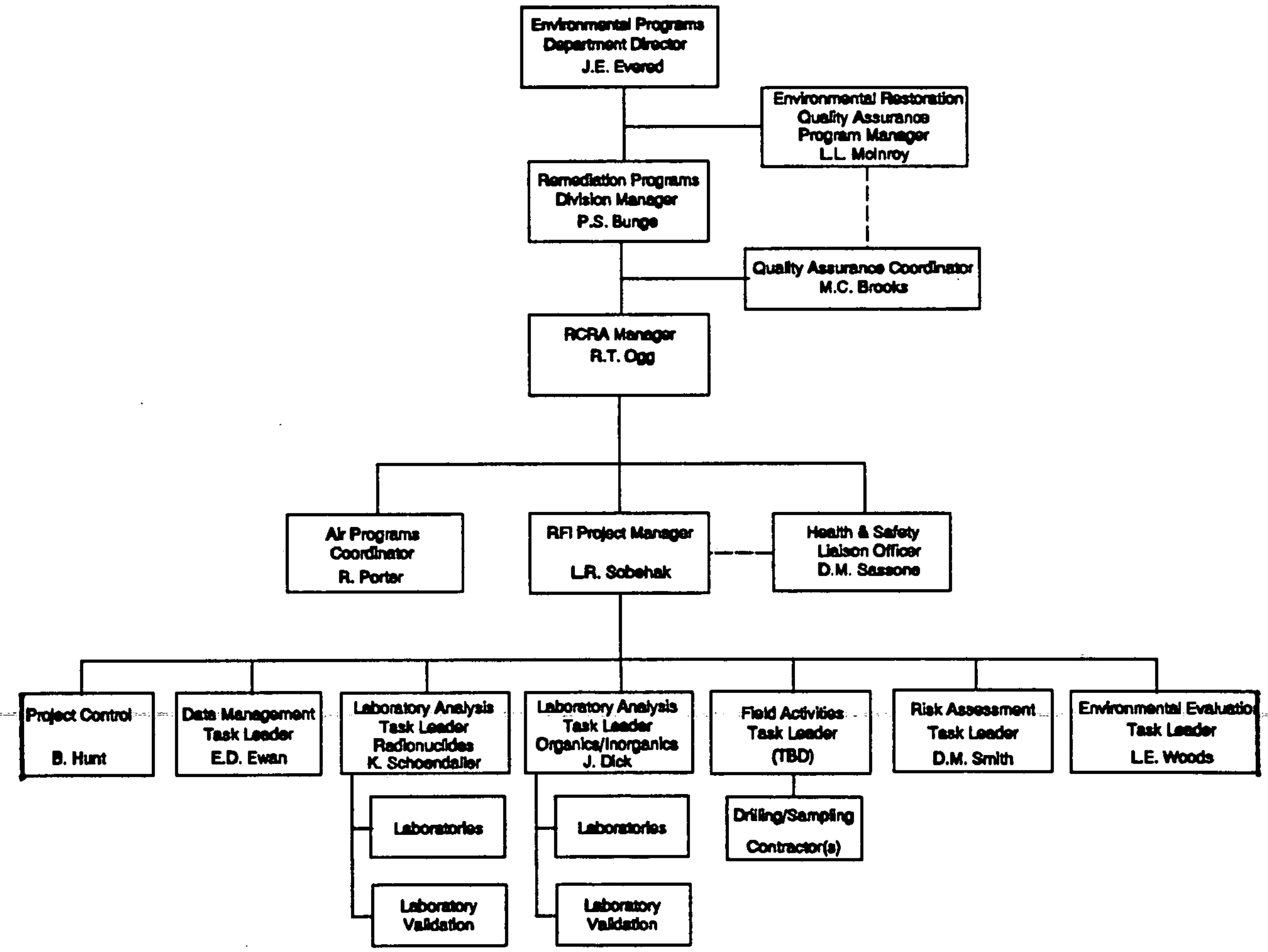
OU10 is one of 16 operable units (OUs) identified for investigations under the Rocky Flats Plant (RFP) Interagency Agreement (IAG). OU10 contains 16 individual hazardous substance sites (IHSSs), which are described in Section 2 of the OU10 WP. The OU10 WP describes the Phase I characterization of source materials and soils at OU10 IHSSs. The OU10 WP was prepared in accordance with the Federal and State of Colorado regulations and guidance documents identified in the Introduction (Section 1.0).

10.1 ORGANIZATION AND RESPONSIBILITIES

The overall organization of EG&G Rocky Flats and the Environmental Management Department (EMD) and divisions involved in Environmental Restoration (ER) Program activities is shown in Figures 1-1, 1-2, and 1-3 of Section 1.0 of the QAPjP. Individual responsibilities are also described in Section 1.0 of the (QAPjP).

Contractors will be tasked by EG&G Rocky Flats to implement the field activities outlined in the OU10 WP. The specific EMD personnel who will interface with the Contractors and who will provide technical direction are shown in Figure 10-1.

FIGURE 1. PROJECT MANAGEMENT FOR OPERABLE UNIT 10 OTHER OUTSIDE CLOSURES, PHASE I RFI/RI



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10.2 QUALITY ASSURANCE PROGRAM

The QAPjP was written to address QA controls and requirements for implementing IAG-related activities. The content of the QAPjP was driven by Department of Energy (DOE) RFP Standard Operating Procedure (SOP) 5700.6B, which requires a QA program to be implemented for all RFP activities based on American Society of Mechanical Engineers (ASME) NQA-1, "Quality Assurance Requirements for Nuclear Facilities," as wall as the IAG, which specifies that a QAPjP for IAG-related activities be developed in accordance with the Environmental Protection Agency (EPA) QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." The 18-element format of NQA-1 was selected as the basis for both the QAPjP and subsequent QAAs with the applicable elements of QAMS-005/80 incorporated where appropriate. Figure 2-1 of the QAPjP illustrates where the 16 QA elements of QAMS-005/80 are integrated into the QAPjP and also into this QAA. Section 2.0 of the QAPjP also identifies other DOE Orders and QA requirements documents to which the QAPjP and this QAA are responsive.

The controls and requirements addressed in the QAPjP are applicable to OU10 Phase I activities, unless specified otherwise in this QAA. Where site-wide actions are applicable to OU10 activities, the applicable section of the QAPjP is referenced in this QAA. This QAA addresses additional and site-specific QA controls and requirements that are applicable to OU10 Phase I activities that may not have been addressed on a site-wide basis in the QAPjP. Many of the QA requirements specific to OU10 are addressed in the OU10 WP and are referenced in this QAA.

10.2.1 Training

Personnel qualification and training requirements for RFP ER Program activities are addressed in Section 2.0 of the QAPjP. Personnel qualifications and training required to perform the EMD Operating Procedures (OPs) that are applicable to OU10 investigations are specified within the respective procedures. The EMD OPs (which have been referred to as SOPs in the QAPjP and the OU10 WP) are identified in Table 10.1.

TABLE 1
Standard Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMD OPS Reference Number	Standard Operating Procedures	Field Screening Surveys	Well Drilling, Completion, Development	Ground-Water Sampling	Surface-Water Sampling	Sediment Sampling	Surface Soil Sampling	Subsurface Soil/Mat. Sampling	Asphalt & Concrete Sampling	Biota Sampling
1.1	F0.01	Wind Blown Contaminant Dispersion Control		●					●		
1.2	F0.02	Field Document Control	●	●	●	●	●	●	●	●	●
1.3	F0.03	General Equipment Decontamination	●	●	●	●	●	●	●	●	●
1.4	F0.04	Heavy Equipment Decontamination		●	●	●	●	●	●	●	●
1.5	F0.05	Handling of Purge and Development Water		●	●						
1.6	F0.06	Handling of Personal Protective Equipment	●	●	●	●	●	●	●	●	●
1.7	F0.07	Handling of Decontamination Water & Wash Water	●	●	●	●	●	●	●	●	●
1.8	F0.08	Handling of Drilling Fluids & Cuttings		●			●		●		
1.9	F0.09	Handling of Residual Samples						●	●	●	●
1.10	F0.10	Receiving, Labeling, and Handling Waste Containers		●	●				●	●	●
1.11	F0.11	Field Communications	●	●	●	●	●	●	●	●	●
1.12	F0.12	Decontamination Facility Operations	●	●	●	●	●	●	●	●	●
1.13	F0.13	Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples			●	●	●	●	●	●	●
1.14	F0.14	Field Data Management	●	●	●	●	●	●	●	●	●
1.15	F0.15	Use of PIDs and FIDs		X	X	X	X	X	X	X	X
1.16	F0.16	Field Radiological Measurements a) Walk-Over Surveys	●	X	X	X	X	X	X	X	X
New	FO.18	Environmental Sample Radioactivity Content Screening			●	●	●	●	●	●	
2.1	GW.01	Water Level Measurements in Wells and Piezometers		●	●						
2.2	GW.02	Well Development		●							
2.5	GW.05	Measurements for Groundwater Field Parameters			●						
2.6	GW.06	Groundwater Sampling			●						

X - As required by H&S plan.

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TABLE 1 (Continued)
Standard Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMD OPS Reference Number	Standard Operating Procedures	Field Screening Surveys	Well Drilling, Completion, Development	Ground-Water Sampling	Surface-Water Sampling	Sediment Sampling	Surface Soil Sampling	Subsurface Soil Sampling	Asphalt and Concrete Sampling	Biota Samples
3.1	GT.01	Logging Alluvial and Bedrock Material		●					●		
3.2	GT.02	Drilling and Sampling Using Hollow-Stem Auger Techniques		●					●		
3.3	GT.03	Isolating Bedrock from the Alluvium with Surface Casing		●					●		
3.4	GT.04	Rotary Drilling and Rock Coring		●					●		
3.5	GT.05	Plugging and Abandonment of Boreholes		●					●		
3.6	GT.06	Monitoring Well and Piezometer Installation		●							
3.8	GT.08	Surface Soil Sampling						●			
3.9	GT.09	Soil Gas Sampling and Field Analysis	●								
3.10	GT.10	Borehole Clearing							●		
3.11	GT.11	Plugging and Abandonment of Wells		●							
New	GT.17	Land Surveying		●					●		
4.1	SW.01	Surface Water Data Collection Activities				●					
4.2	SW.02	Field Measurement of Surface Water Parameters				●					
4.3	SW.03	Surface Water Sampling				●					
4.6	SW.06	Sediment Sampling					●				
5.1	EE.01	Sampling of Periphyton									●
5.2	EE.02	Sampling of Benthic Macroinvertebrates									●
5.3	EE.03	Sampling of Plankton									●
5.4	EE.04	Sampling of Fishes									●
5.5	EE.05	Sampling of Large Mammals									●
5.6	EE.06	Sampling of Small Mammals									●
5.7	EE.07	Sampling of Birds									●
5.8	EE.08	Sampling of Reptiles and Amphibians									●
5.9	EE.09	Sampling of Terrestrial Arthropods									●
5.10	EE.10	Sampling of Terrestrial Vegetation									●
5.11	EE.11	Identification of Habitat Types									●
5.12	EE.12	Sampling of Soil for Soil Description									●
5.13	EE.13	Development of Field Sampling Plans									●

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10.2.2 Quality Assurance Reports to Management

A QA summary report will be prepared annually or at the conclusion of these activities (whichever is more frequent) by the EMD Quality Assurance Project Manager (QAPM) or designee. This report will include a summary of field operation and laboratory inspections, surveillance, and audits and a report on data verification/validation results.

10.3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

10.3.1 Design Control

The OU10 WP describes the investigation activities that will be implemented during the Phase I characterization of the OU10 IHSSs. The OU10 WP identifies the objectives of the investigations; specifies the sampling, analysis, and data generation requirements; and identifies applicable operating procedures that will provide controls for the investigations. As such, the OU10 WP is considered the investigation control plan for OU10 Phase I RFI/RI activities.

10.3.2 Data Quality Objectives

Data needs and data quality objectives (DQOs) for OU10 Phase 1 investigations are addressed in Section 4, and Section 9.2.1 for the Environmental Evaluation (EE) data. Identification of data needs and objectives assist decision makers in determining what the quality of the data should be, which in turn dictates the type of quality controls that are necessary to ensure that data of appropriate quality is generated. The DQOs for the OU10 Phase I investigations were established in accordance with Appendix A of the QAPjP. Data quality can be measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). These parameters are defined in Appendix A of the QAPjP.

PARCC parameter goals are established prior to initiating investigations in order to assist decision makers in determining if DQOs for measurement data have been met. Historical precision and accuracy measures for EPA Contract Laboratory Program (CLP) analytical methods have been determined. These historical measures have been selected as the goals for all Analytical IV and V data. (Analytical levels are defined and discussed in Appendix A of the QAPjP.) The precision and accuracy goals for Analytical Level IV and V data for EPA Target Analyte List, Target Compound List, and several indicator analytes are listed in Appendix B of the QAPjP. Precision and accuracy goals for Analytical Level I and II data, which consists of field screening and analysis measurements, have been established for several parameters and are also presented in Appendix B of the QAPjP. Table 4-1 of the OU10 WP identifies the analytical levels for each type of data to be generated during Phase I investigations. Goals for representativeness, comparability, and completeness for the RFP ER Program investigations, including OU10 Phase I investigations, are discussed in Appendix A of the QAPjP.

The ecological characterization activities described in Section 9 are considered screening activities that, typically, require Analytical Level I and II data. These characterization data will then be used, along with the OU10 RFI/RI characterization and source contamination data, to develop the conceptual model for the EE study. Data quality for these characterization activities will be controlled by adhering to the field sampling operating procedures in implementing the EE Field Sampling Plan (Section 9.3).

The conceptual model developed for the OU10 ecosystem will assist investigators in identifying site-specific target species, contaminants of concern, and potential exposure pathways. Additional DQOs for the contamination assessment tasks (Tasks 4 through 7 of Section 9) and the ecotoxicological studies (Task 8) will then be developed following steps recommended by the EPA in EPA/600/3-89/013, Ecological Assessments of Hazardous Waste Sites: A Field Guide and Laboratory Reference Document, and EPA/540/G-90/008, Guidance for Data Usability in Risk Assessment. The ecosystem characterization data and preliminary aquatic toxicity investigation data that will be obtained by implementing the EE Field Sampling Plan are needed to develop these additional DQOs.

10.3.3 Sampling Locations and Sampling Procedures

Sampling locations and frequencies for radiation, soil gas, asphalt/concrete, soil, sediment, surface water, and groundwater for each IHSS are addressed in Section 7.3 and summarized in Table 7-1. Sampling equipment and procedures for this sampling are identified in Section 7.4. Sampling locations and frequencies for the EE program, consisting of vegetation, periphyton, benthic macroinvertebrate, fish, and small mammals sampling, are addressed in Section 9.3. EE surveying and sampling procedures are identified in Section 9.4.

The operating procedures that are applicable to OU10 Phase I field activities and the particular activities to which they are applicable are summarized in Table 10.1.

10.3.4 Analytical Procedures

The analytical program for OU10 Phase I RFI/RI investigation is discussed in Section 7.5. The analytes of interest and the specified detection limits are identified in Table 7.2. The analytical methods that shall be adhered to are those that are specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B. These methods are referenced in Section 3.0 of the QAPjP. Specific analytical methods for each analyte identified in Section 7.5 are referenced in Appendix B of the QAPjP.

10.3.5 Equipment Decontamination

Non-dedicated sampling equipment (i.e., sampling equipment that is used at more than one location) shall be decontaminated between sampling locations in accordance with OPS-FO.03, General Equipment Decontamination. Other equipment (e.g., heavy equipment) potentially contaminated during drilling, hydrogeologic/geologic testing, boring, sample collection, etc. shall also be decontaminated as specified in OPS-FO.04, Heavy Equipment Decontamination.

10.3.6 Air Quality

Air monitoring will be conducted during implementation of field activities that have the potential to create windblown dispersion of contaminants, including drilling, coring, and installation of boreholes and monitoring wells. Air monitoring will ensure that OU10 RFI/RI activities comply with the RFP Interim Plan for Prevention of Contaminant Dispersion. Air monitoring will be conducted according to OPS-FO.01, Wind Blown Contaminant Dispersion Control.

10.3.7 Quality Control

To ensure the quality of the field sampling techniques, collection and/or preparation of field quality control (QC) samples are incorporated into the sampling scheme. Field QC samples and collection frequencies for OU10 are addressed in Section 7.6 and identified in Table 7-6. A specific sampling schedule will be prepared by the sampling subcontractor for approval by the EG&G Laboratory Analysis Task Leader (Figure 10-1) prior to sampling.

10.3.7.1 Objectives for Field QC Samples:

Equipment rinsate blanks are considered acceptable (with no need for data qualification) if the concentration of analytes of interest is less than three times the required detection limit for each analyte as specified in Table 7.2. Field duplicate samples shall agree within 30 percent relative percent difference for aqueous samples and 40 percent for homogenous, non-aqueous samples.

Trip blanks and field preservation blanks (for organics and inorganics, respectively) indicate possible field contamination when analytes are detected above the minimum detection limits presented in Table 7-2. The Laboratory Analysis Task Leader (Figure 10-1) is responsible for verifying these criteria and shall be responsible for checking to see if they are met and for qualifying data.

10.3.7.2 Laboratory QC

Laboratory QC procedures are used to provide measures of internal consistency of analytical and storage procedures. The laboratory contractor will submit written SOPs to the Laboratory Analysis Task Leader for approval. The interlaboratory SOPs shall be consistent with or equivalent to EPA-CLP QC procedures. The laboratory SOPs must cover the following areas in sufficient detail and reflect actual operating conditions in effect during analysis of EG&G RFP samples:

- Sample receipt and log-in
- Sample storage and security
- Facility security
- Sample tracking (from receipt to sample disposition)
- Sample analysis method references
- Data reduction, verification, and reporting
- Document control (including submitting documents to EG&G)
- Data package assembly (see Section III.A of the GRRASP)

- Qualifications of personnel
- Preparation of standards
- Equipment maintenance and calibration
- List of instrumentation and equipment (including date purchased, date installed, model number, manufacturer, and service contracts, if any)
- Instrument detection limits
- Acceptance criteria for non-CLP analyses
- Laboratory QC checks applicable to each analytical method

Laboratory QC techniques to ensure consistency and validity of analytical results (including detecting potential laboratory contamination of samples) include using reagent blanks, field blanks, internal standard reference materials, laboratory replicate analysis, and field duplicates. The laboratory contractor will follow the standard evaluation guidelines and QC procedures, including frequency of QC checks, that are applicable to the particular type of analytical method being used as specified in Parts A and B of the GRRASP and Section 3.0 of the QAPjP. All data packages will be forwarded to the Laboratory Analysis Task Leader or validation contractor (Figure 10-1) for review and verification.

10.3.8 Quality Assurance Monitoring

To assure the overall quality of the RFI/RI activities discussed in the OU10 WP, field inspections will be conducted daily and audits and surveillance will be conducted at various intervals. The intervals will be determined by the importance and complexity of each activity. Intervals will also be based on the schedule contained in Section 6.0. At a minimum, each of the field sampling activities described in Sections 7.3 and 9.3 will be monitored by an independent surveillance team at least once during the sampling process. EG&G will conduct audits of the laboratory contractor(s) as specified in the GRRASP, Parts A and B. The audits and surveillance, and activity Readiness Reviews are discussed further in Section 10.18.

10.3.9 Data Reduction, Validation, and Reporting

10.3.9.1 Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of Section 3.0 of the QAPjP.

10.3.9.2 Data Reduction

Reduction of laboratory measurements shall be in accordance with the methods specified for each analytical method. Laboratory data will be compiled into sample data packages by the laboratory contractor. A sample data package shall be developed for each sample delivery group or sample batch, with separate data packages for each type of analysis (e.g., a data package for organics, one for inorganics, one for water quality parameters, and one for radionuclides). The sample data package shall consist of a cover sheet/transmittal letter, a case narrative, data summary forms, and copies of the data checklists found in Attachments I in Parts A and B of the GRRASP. The reduced data will be used in the data validation process to verify that the laboratory control and the overall system DQOs have been met.

10.3.9.3 Data Validation

Validation activities consist of reviewing and verifying field and laboratory data and evaluating these verified data for data quality (i.e., comparison of reduced data to DQOs, where appropriate). The field and laboratory data validation activities and guidelines are described and referenced in Section 3.0 of the QAPjP. The process for validating the quality of the data is illustrated graphically in Figure 3-1 of Section 3.0 of the QAPjP, and is also included as part of the sample collection, chain-of-custody, and analysis process illustrated in Figure 8-1 of Section 8.0 of the QAPjP. The criteria for determining the validity of ER data at Rocky Flats are described in subsection 3.3.7 of Section 3.0 of the QAPjP.

10.3.9.4 Data Reporting

Depending on the data validation process, data are flagged as either "valid," "acceptable with qualifications," or "rejected." The results of the data validation shall be reported in ER Department Data Assessment Summary reports. The usability of data (the criteria of which is also described in subsection 3.3.7 of Section 3.0 of the QAPjP) shall also be addressed by the RFI Project Manager.

10.4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services, including services for conducting field investigations and analytical laboratories, shall be prepared, handled, and controlled in accordance with the requirements and methods specified in Section 4.0 of the QAPjP.

10.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The OU10 WP describes the activities to be performed. The OU10 WP will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP.

EMD OPS approved for use are identified in Table 10.1, which also indicates their applicability. Any additional quality-affecting procedures proposed for use but not identified in Table 10.1 will be developed and approved as required by Section 5.0 of the QAPjP prior to performing the affected activity.

Changes and variances to approved operating procedures and the OU10 WP shall be documented through preparation of Document Change Notices (DCNs), which will be prepared, reviewed, and approved in accordance with requirements specified in Section 5.0 of the QAPjP. (Note: DCNs were referred to as Procedure Change Notices in Revision 0 of the QAPjP).

10.6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6.0 of the QAPjP:

- "Phase I RFI/RI Work Plan for Other Outside Closures, Operable Unit No. 10"
- "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures *Studies Activities*" (QAPjP)

- Quality Assurance Addendum (QAA) to the Rocky Flats Site-Wide QAPjP for Operable Unit No. 10, Other Outside Closures, Phase I RFI/RI Activities
- EMD Operating Procedures (all operating procedures specified in the QAPjP, this QAA, and to-be-developed laboratory SOPs).

10.7 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU10 WP activities will be selected and evaluated as outlined in Section 7.0 of the QAPjP. This includes preaward evaluation/audit of proposed contractors as well as periodic audit of the acceptability of contractor performance during the life of the contract. Any items or materials that are purchased for use during the OU10 investigations that have the ability to affect the quality of the data shall be inspected upon receipt.

10.8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

10.8.1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for water and soil samples are presented in Tables 7-4 and 7-5. Requirements for EE samples are included here in Table 10.2.

10.8.2 Sample Identification

RFI/RI samples shall be labeled and identified in accordance with Section 8.0 of the QAPjP and OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Samples shall have unique identification that traces the sample to the source(s) and indicates the method(s), date, the sampler(s), and conditions prevailing at the time of sampling.

10.8.3 Chain-of-Custody

Sample chain-of-custody will be maintained through the application of OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, and as illustrated in Figure 8-1 of the QAPjP for all environmental samples collected during field investigations.

10.9 CONTROL OF PROCESSES

The overall process of collecting samples, performing analysis, and inputting the data into a database is considered a process that requires control. The process is controlled through a series of written procedures that govern and document the work activities. A process diagram is shown in Section 8.0 of the QAPjP.

TABLE 10.2

HOLDING TIMES, PRESERVATION METHODS, AND SAMPLE CONTAINERS FOR BIOTA SAMPLES

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size*
SAMPLES FOR METALS ANALYSES				
TERRESTRIAL VEGETATION				
- Metals Determined by ICP**	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Metals Determined by GFAA***	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Mercury	28 days	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	5 g
Periphyton and Benthic Macroinvertebrates				
- Metals Determined by ICP	6 mos.	Freeze & ship w/dry ice	Plastic	25 g
- Metals Determined by GFAA	6 mos.	Freeze & ship w/dry ice	Plastic	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/dry ice	Plastic	25 g
- Mercury	28 days	Freeze & ship w/dry ice	Plastic	5 g

TABLE 10.2

HOLDING TIMES, PRESERVATION METHODS, AND SAMPLE CONTAINERS FOR BIOTA SAMPLES

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size*
SAMPLES FOR RADIONUCLIDE ANALYSES				
Terrestrial Vegetation				
- Uranium 223, 234, 235, 238 Americium 241 Plutonium 239, 240	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	1 kg
Periphyton and Benthic Macroinvertebrates				
- Uranium 233, 234, 235, 238 Americium 241 Plutonium 239, 240	6 mos.	Freeze & ship w/dry ice	Plastic	1 kg

* Sample size may vary with specific laboratory requirements.

**ICP = Inductively Coupled Argon Plasma Emission Spectroscopy. Metals to be determined include Ba, Cr, Cu, and Fe.

***GFAA = Graphite Furnace Atomic Absorption Spectroscopy. Metals to be determined include As, Cd, Li, Pb, Se, and Sr.

10.10 INSPECTION

Procured materials and construction activities (e.g., groundwater monitoring well installation) shall be inspected (as applicable) in accordance with the requirements specified in Section 10.0 of the QAPjP.

10.11 TEST CONTROL

Test control requirements specified in Section 11.0 of the QAPjP are not applicable to any of the RFI/RI investigations described in the OU10 WP.

10.12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

10.12.1 Field Equipment

Specific conductivity, temperature, pH, and dissolved oxygen content, chlorine, turbidity, and alkalinity of water samples shall be measured in the field. Field measurements will be taken and the instruments calibrated as specified in OPS-SW.02, Field Measurements of Surface Water Parameters. Measurements shall be made using the following equipment (or EG&G-approved alternates):

- Temperature: mercury-filled, teflon-coated, safety-type thermometer (VWR catalogue No. 6107-832 or equivalent), or digital readout thermistor (VWR Catalogue No. 61017-562 or equivalent)
- Specific Conductivity: HACH 44600 Conductivity/TDS Meter
- Dissolved Oxygen: HACH or YSI Model 57 Dissolved Oxygen Meter
- pH: HACH One pH Meter (this meter may also be used for temperature measurements)
- Chlorine and Turbidity: HACH DR2000 spectrophotometer
- Alkalinity: HACH digital titrator

In addition to the field measurements for water quality, field measurements for radiation, soil gas, and VOCs in ground water will also be made. The following instruments will be used for these measurements.

- Radiological field readings for field survey grid locations and drill cuttings, core, and samples: A side-shielded field instrument for detection of low energy radiation (FIDLER), Ludlum Model 12-1A or equivalent. Use, calibration, and maintenance according to OPS-FO-16, Field Radiological Measurements.
- Field readings for soil gas and VOCs in groundwater: A portable photoionization detector (PID), HNU Systems P1-101 or equivalent. Use, calibration, and maintenance according to OPS-FO.15, Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs).

Each piece of field equipment shall have a file that contains:

- Specific model and instrument serial number
- Operating instructions
- Routine preventative maintenance procedures, including a list of critical spare parts to be provided or available in the field
- Calibration methods, frequency, and description of the calibration solutions
- Standardization procedures (traceability to nationally recognized standards).

The above information shall, in general, conform to the manufacturer's recommended operating instructions or shall explain the deviation from said instructions.

10.12.2 Laboratory Equipment

Laboratory analyses will be performed by contracted laboratories. The equipment used to analyze environmental samples shall be calibrated, maintained, and controlled in accordance with the requirements contained in the specific analytical protocols used as specified in the GRRASP. This information will be supplied to EG&G as a laboratory SOP.

10.13 HANDLING, STORAGE, AND SHIPPING

Samples shall be packaged, transported, and stored in accordance with OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Maximum sample holding times, sample preservative, sample volumes, and sample containers are specified in Table 8-1 of Section 8.0 of the QAPjP. Sample handling and storage controls at the laboratory shall be provided as a laboratory SOP.

10.14 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status shall be implemented as specified in Section 14.0 of the QAPjP. A log specifying the status of all boreholes and groundwater monitoring wells shall be maintained by the Field Activities Task Leader, which will include well/borehole identification number, ground elevation, casing depth of hole, depth to bedrock, static water level (as applicable), depth to top and bottom of screen (as applicable), diameter of hole, diameter of casing, and top/bottom of casing.

10.15 CONTROL OF NONCONFORMANCES

The requirements for the identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15.0 of the QAPjP. Nonconformances identified by the implementing contractor shall be submitted to EG&G for processing as outlined in the QAPjP.

10.16 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16.0 of the QAPjP. Conditions adverse to quality identified by the implementing contractor shall be documented and submitted to EG&G for processing as outlined in the QAPjP.

10.17 QUALITY ASSURANCE RECORDS

QA records will be controlled in accordance with OPS-FO.02, Field Document Control. QA records to be generated during OU10 RFI/RI activities include, but are not limited to:

- Field Logs and Data Record Forms (e.g., sample collection notebooks/logs for water, sediment, and air)
- Calibration Records
- Sample Collection and Chain-of-Custody Records
- Laboratory Sample Data Packages
- Drilling Logs
- Work Plan/Field Sampling Plan
- QAPjP/QAA
- Audit/Surveillance/Inspection Reports
- Nonconformance Reports
- Corrective Action Documentation
- Data Validation Results
- Data Reports
- Procurement/Contracting Documentation
- Training/Qualification Records
- Inspection Records

10.18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section No. 18 of the QAPjP. EG&G will conduct audits of the laboratory contractor as specified in the GRRASP, Parts A and B. The EMD QAPM shall develop a surveillance schedule with the surveillance intervals based on the importance and complexity of each sampling/analytical activity. Intervals will also be based on the schedule contained in Section 6.0.

Examples of some specific tasks that will be monitored by the surveillance program are as follows:

- Borings and well installations (approximately 10 percent of the holes)

- Field sampling (approximately 5 percent of each type of sample collected)
- Records management (a surveillance will be conducted once at the initiation of OU10 activities, and monthly thereafter)
- Data verification, validation, and reporting

Audits of contractors providing field investigation, construction, and analytical support services shall be performed at least annually or once during the life of the project, whichever is more frequent.

A Readiness Review shall be conducted by the EMD QAPM prior to the implementation of OU10 field investigation activities. The readiness review will determine if all activity prerequisites have been met that are required to begin work. The applicable requirements of the QAPjP and this QAA will be addressed.

10.19 SOFTWARE CONTROL

The requirements for the control of software shall be implemented as specified in Section 19.0 of the QAPjP. Only database software is anticipated to be used for the OU10 WP activities. Operating procedures applicable to the use of the database storing environmental data can be found in OPS-FO.14, Field Data Management.

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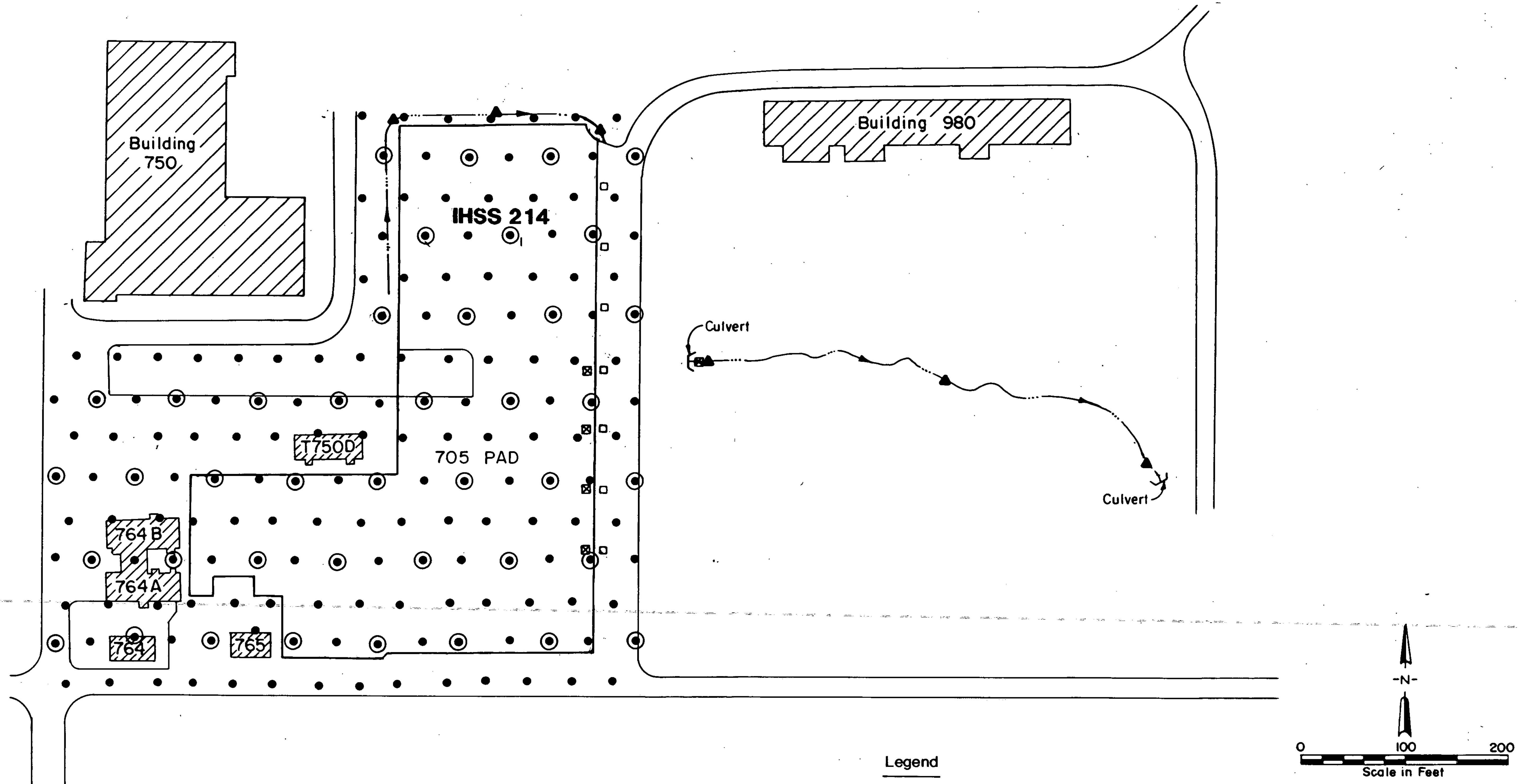

Legend

Surface Drainage, Indicating Direction of Flow
Drain
Previous Soil Sample Locations
Proposed Surficial Soil Sample Location
Proposed Sediment and Surface Water Sample Location
Proposed Radiation Sampling Location
Random Coordinate Generated for Sampling Grid

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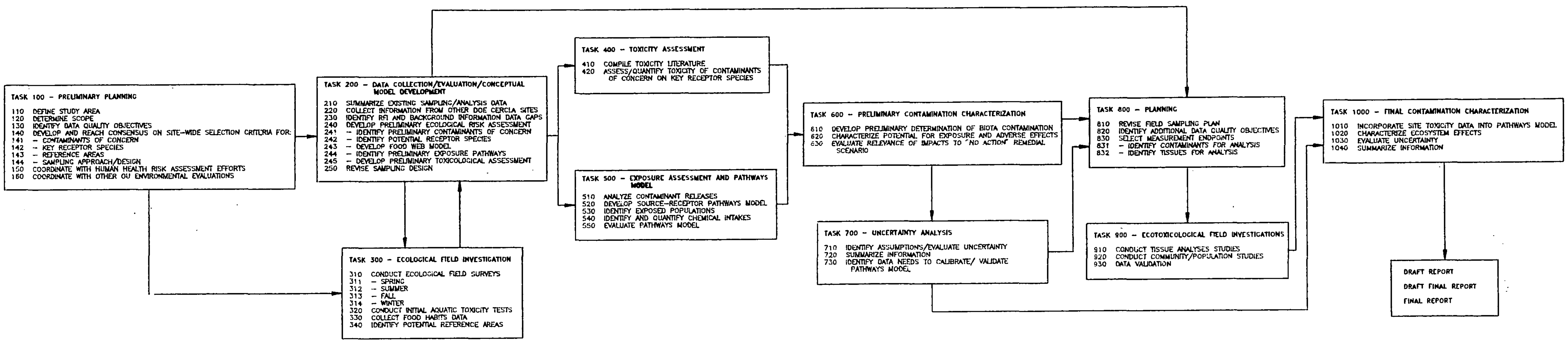
FIGURE 7.3-16
Proposed Sampling Locations for Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)



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OPERABLE UNIT 1
PHASE III RFI/RI WORK PLAN

FLOW DIAGRAM:
INTERRELATIONSHIPS BETWEEN TASKS

FIGURE 9.1-1 OCTOBER 1991

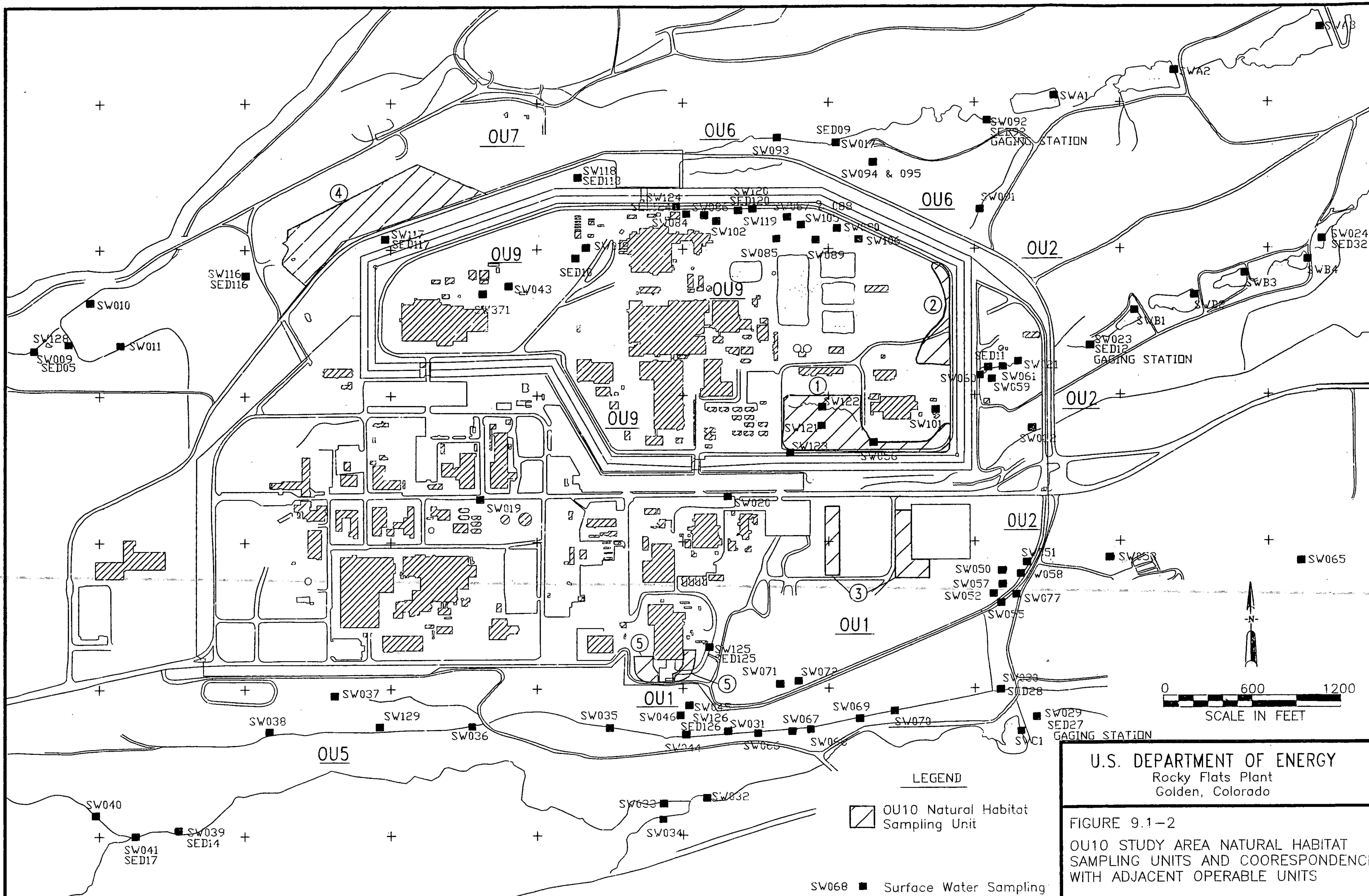

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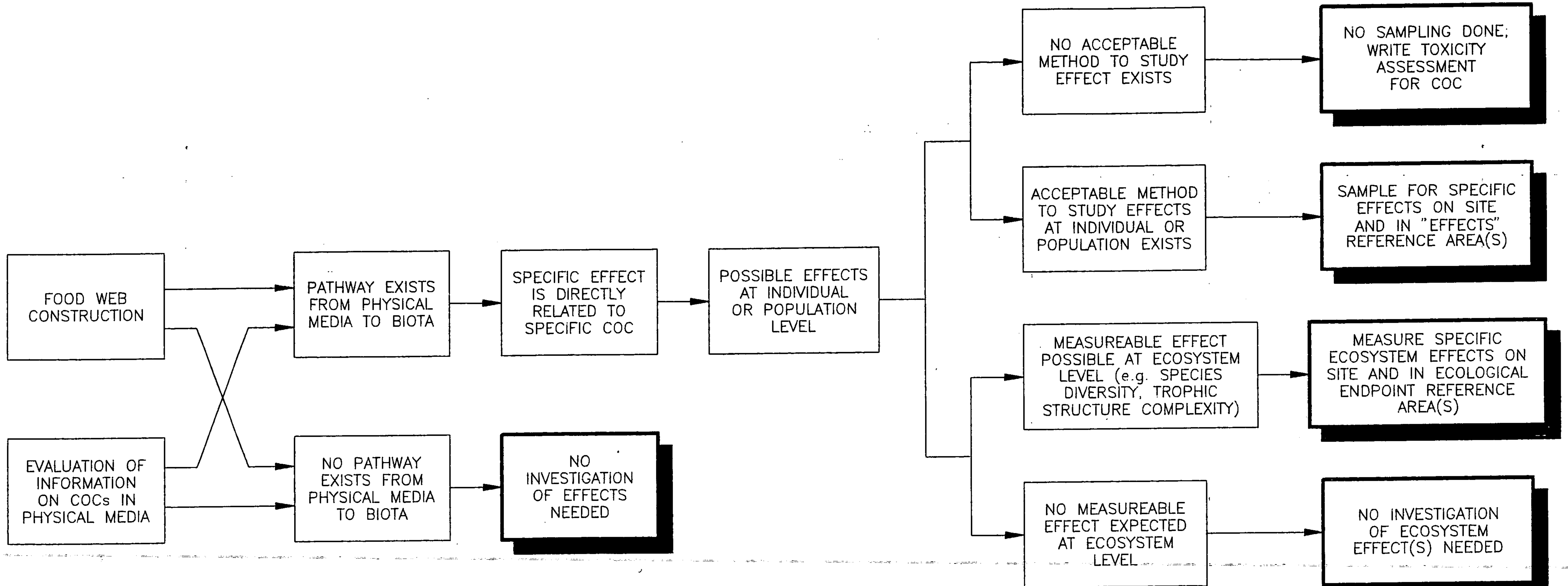
FIGURE 9.1–2

OU10 STUDY AREA NATURAL HABITAT SAMPLING UNITS AND COORESPONDENCE WITH ADJACENT OPERABLE UNITS



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OPERABLE UNIT 10
PHASE I RFI/RI WORK PLAN

DECISION PROCESS FOR THE INVESTIGATION OF INDIVIDUAL, POPULATION, AND ECOSYSTEM LEVEL EFFECTS AND FOR THE USE OF REFERENCE AREAS FOR COC EFFECTS

FIGURE 9.1-3 OCTOBER 1991

2506E003

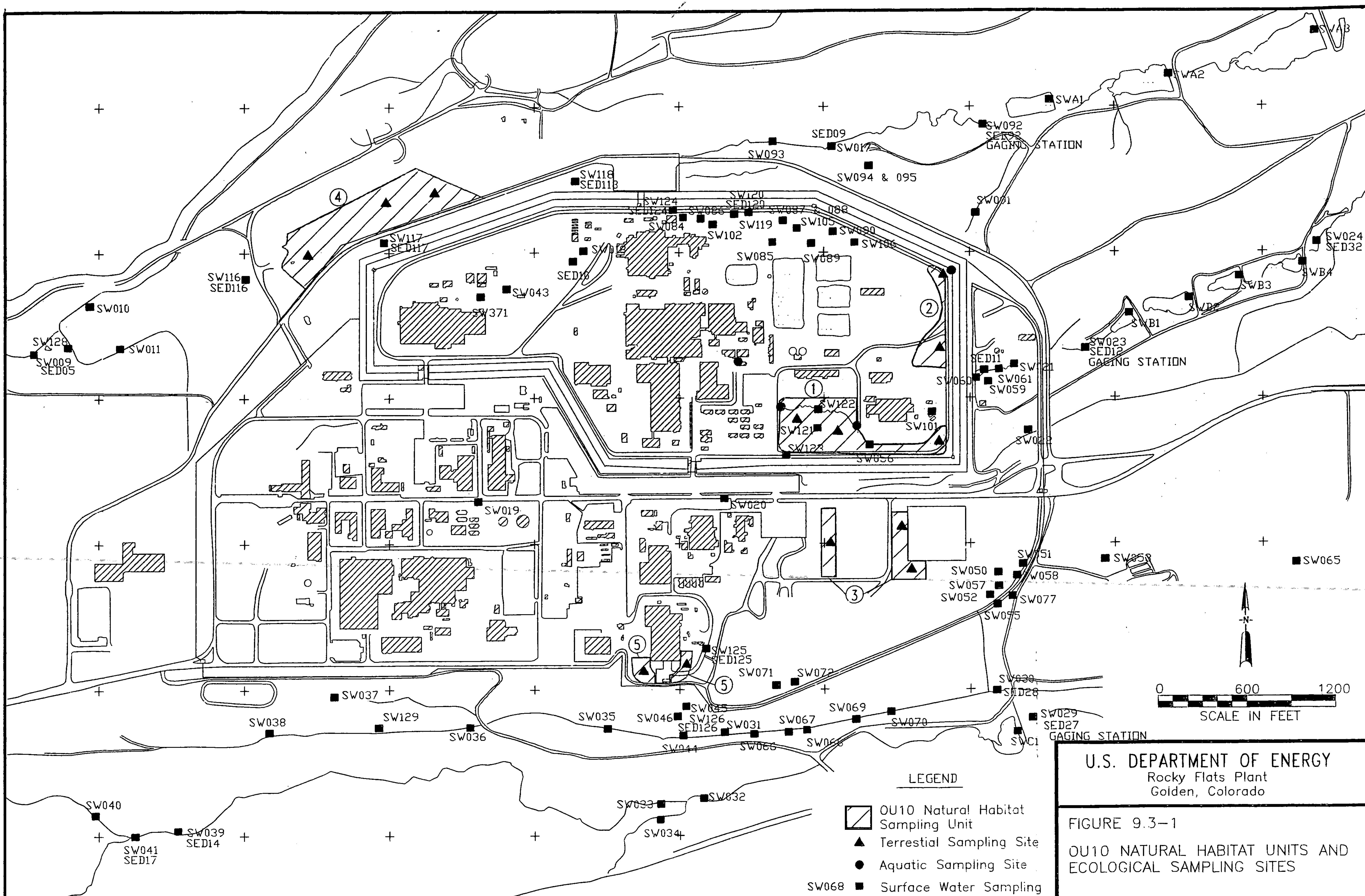

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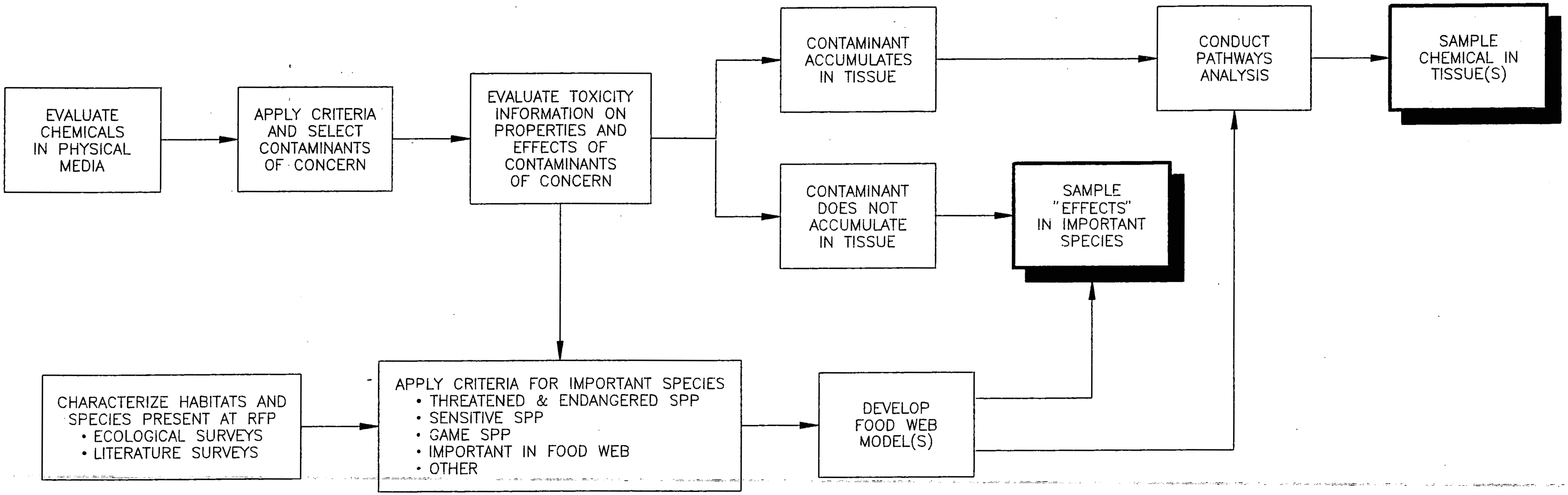
FIGURE 9.3-1

OU10 NATURAL HABITAT UNITS AND ECOLOGICAL SAMPLING SITES



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OPERABLE UNIT 10
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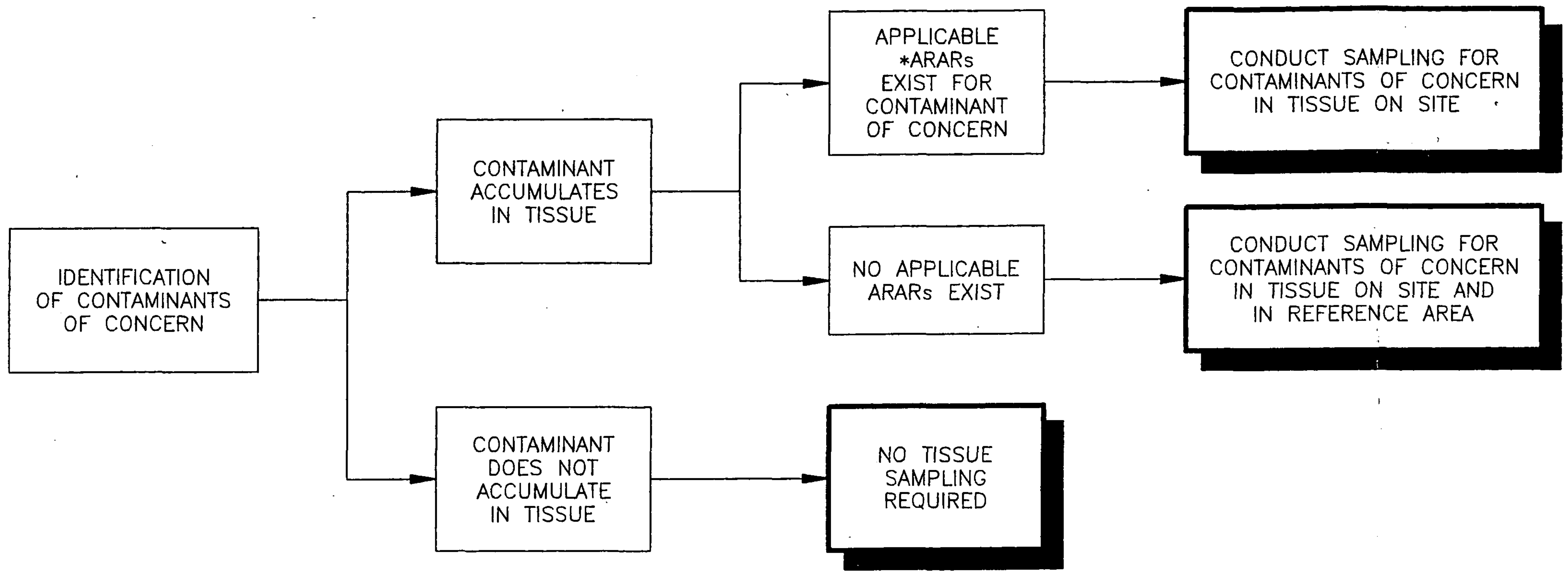
DECISION PROCESS FOR CHEMICAL SAMPLING OF TISSUES

FIGURE 9.1-5 OCTOBER 1991

2506E001



* ARARs MAY NOT BE APPLICABLE IF THEY ARE BASED ON SPECIES THAT DO NOT EXIST ON SITE (e.g., TROUT) OR IF THEY ARE BASED ON BIOTA PATHWAYS TO HUMANS.

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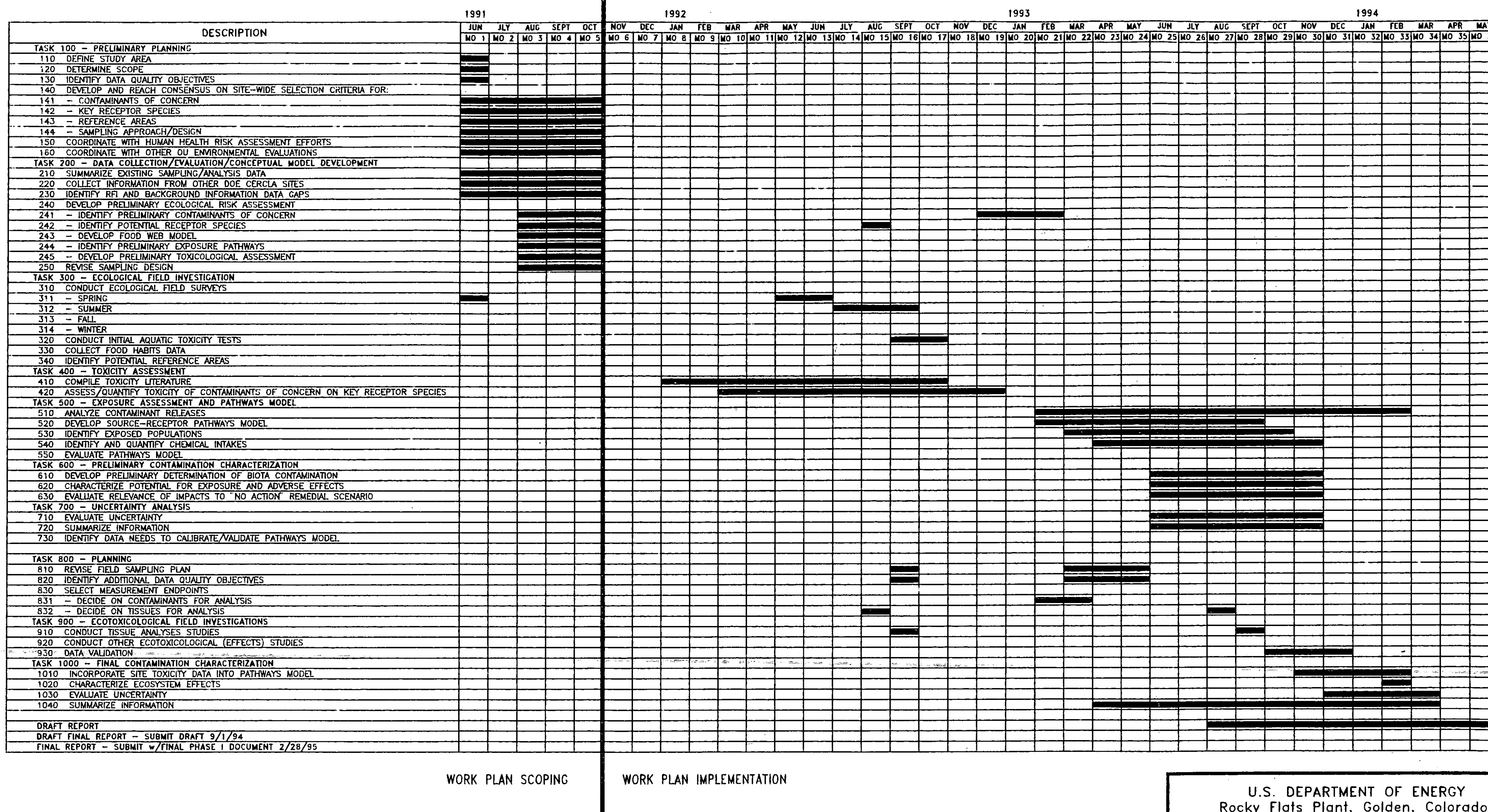
OPERABLE UNIT 10
PHASE I RFI/RI WORK PLAN

DECISION PROCESS ON USE OF REFERENCE AREAS FOR CONTAMINANTS IN TISSUES

FIGURE 9.1-6 OCTOBER 1991

2506E002



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OPERABLE UNIT 10
PHASE I RFI/RI WORK PLAN

ENVIRONMENTAL EVALUATION ACTIVITY SCHEDULE FOR OTHER OUTSIDE CLOSURES

FIGURE 9.4-1 OCTOBER 1991

2506E690